





BRITISH MARINE POLYZOA.

VOL. I.

A
HISTORY
OF THE
BRITISH MARINE POLYZOA.

BY
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"... naturâ ipsâ docente, et jucunditate suâ alliciente."
OTHO FABRICIUS.

IN TWO VOLUMES.

VOL. I.—TEXT.

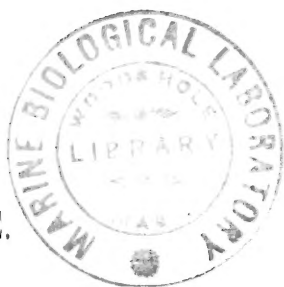
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MDCCCLXXX.

“MONOGRAPHERS, come from whence they may, have, I think, fair pretence to challenge some regard and approbation from the lovers of Natural History; for as no man can alone investigate all the works of Nature, these partial writers may each in his department be more accurate in their discoveries and freer from errors than more general writers, and so by degrees may pave the way to an universal, correct Natural History.”

GILBERT WHITE.

P R E F A C E.



Two things I desire to do in this Preface—to indicate briefly the aim which I have had before me in the preparation of the present work, and to acknowledge the friendly cooperation and help which have contributed so largely to give it the measure of completeness which it may possess.

I must remind the reader that the work professes to be a 'History;' and as such I have endeavoured to make it, so far as my opportunities would permit, an exhaustive account of the organisms with which it deals. I have not aimed at the terse and almost epigrammatic diagnosis in which some of the early systematists excelled, believing that it no longer meets the requirements of science. I have substituted for it detailed and minute description, taking account, not merely of a few salient characters, but of all the minor features and varietal modifications of the specific type. If in some cases it should seem that an undue space has been allotted

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to apparently trivial particulars, it must be remembered that it is precisely in these that we often meet with the most suggestive genealogical hints, and discover the earliest stages of that process of minute progressive change which has resulted in such richly varied modification of organic form.

It is needless to say a word in these days on behalf of the careful study of *varieties*; it has been my endeavour in the present work to exhibit them in their faint beginnings, as well as in their fuller development.

Our attempts at the Classification of the Polyzoa must still, I fear, be in large measure provisional; but it is certainly time that the purely artificial methods of the past should give place to a system aiming, at least, to represent the natural relationships.

The arrangement which I have adopted has many points of agreement, so far as general principles are concerned, with that which we owe to the able Swedish zoologist, Professor Smitt; and I desire here to acknowledge my many obligations to his suggestive writings. Though its details may be open in some respects to criticism, it will, I trust, help the student towards a truer conception of the relation of the different forms and the significance of their morphological characters.

Whatever changes of system may come, I may be allowed to hope that the minute and careful study of the individual species, of which this 'History' is the record, may retain some permanent value, and may

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perhaps help the workers who succeed me to better results than I have attained.

It only remains to discharge the pleasant duty of acknowledging the various assistance which has been so freely rendered to me.

To Mr. Busk I am under great obligations for the readiness with which, through many years, he has given me the benefit of his extensive knowledge and large stores of material, and for his friendly sympathy amidst the difficulties incident to my work.

From the Rev. A. M. Norman I have received invaluable assistance. His unsurpassed collections, comprising the rich inheritance bequeathed by the late Mr. Barlee, and the fruit of his own extensive dredgings, have been placed unreservedly at my service. Unique specimens of great value, and the types of the species described by himself, have been freely lent, in spite of all the risks of transit, and have been left in my hands as long as wanted. Many of the figures in this work have been drawn from examples which his kindness has supplied. I also owe to him the opportunity of examining extensive series of specimens, such as only a collection like his could supply, thus making a more complete study of the species than would have been otherwise possible. And, in addition to this material help, most bountifully rendered, I have also to acknowledge much valuable information, especially respecting the distribution of the Polyzoa, which has been freely placed at my disposal. The service which Mr. Norman has rendered me has been large in extent and peculiar in kind,

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and I can only hope that I may in some measure have repaid him for it by turning to account the material which he has so liberally supplied, in the interests of our favourite science.

My old friend and ally Mr. Peach has kindly helped me, both with his rich collections and his large experience as a practical naturalist.

To Dr. M'Intosh I am indebted for interesting specimens, and, still more, for very valuable suggestions and for the communication of his views on some of the difficult problems with which I have had to deal.

Professor Ray Lankester has most obligingly furnished me with information which I needed respecting those branches of my subject on which he is so high an authority.

Mr. Leipner has freely supplied me with his beautiful mountings of the Polyzoa, in which they may be studied almost as when living—and has thus given me most important assistance, especially in the investigation of the Ctenostomatous forms.

To Mr. Alfred Bell I owe an extensive list of Polyzoa from the Upper and Post-Tertiary deposits, accompanied by valuable notes on the character and arrangement of the beds.

I have to thank Principal Dawson, of McGill University, Montreal, for a very interesting series of species from the St. Lawrence and from the Canadian Post-Pliocene deposits, which he has so ably investigated.

To Dr. J. Barrois, of Lille, I am under peculiar obligations for his courtesy in permitting me to re-

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produce some of the admirable figures from his great work on Polyzoan Embryology, and also communicating to me some of the latest results of his researches—a service for which my warmest acknowledgments are due.

I certainly have reason for holding that good fellowship and an unselfish devotion to the interests of science are still the prevalent characteristics of the naturalist. May they be perpetual!

In the preparation of this work I have had the cordial cooperation of the Publisher, to whom British Natural History owes so much, and who is still true to the honourable traditions of his house.

The Plates bear witness to Mr. Hollick's admirable accuracy, and to his power of rendering the minutest detail with perfect fidelity. It is also right that Mr. Evans and Mr. Kirchner should have the credit of the Woodcuts, which do justice to their subjects.

In closing the pleasant labour of many years, I may take up the lament of that fine old student of nature, Otho Fabricius, "*non sine dolore multa intacta relinquere coactus fui*;" and (under a full sense of the imperfections of my work, beyond its mere incompleteness) I add, with him, "*unico illo solatio fretus, QUOD ÆTAS SUPPLERET DEFICIENTIA.*"

T. H.

Budleigh-Salterton, Devon,
November 1879.

“Naturalists now look upon the study of *varieties* as more important than that of well-fixed species. It is in the former that we see nature still at work, in the very act of producing those wonderful modifications of form, that endless variety of colour, and that complete harmony of relations, which gratify every sense and give occupation to every faculty of the true lover of nature.”

A. R. WALLACE.

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FARRELLA.

Showing the mode in which the polypide is stowed away in its cell during retraction.

INTRODUCTION.

THE *Polyzoa* are almost universally composite animals*, forming colonies, often of considerable extent, which are the product of repeated, continuous gemmation. They are all inhabitants of water, and for the most part of the sea; but a comparatively small though very interesting group has its home in fresh water—in river, stream, pond, or lake.

They present the greatest variety of form and habit, which cannot be generalized in any definite formula. Sometimes they grow in plant-like tufts, composed of series of cells variously linked together; sometimes they spread over shell or stone, like the finest lacework or fairy chains; sometimes they rise into stony corals, or broad and flexile fronds. At times they bury the seaweed beneath their fleshy crusts, or invest it with silvery network. In many of the stony kinds the cells are richly sculptured and exhibit an immense amount of microscopic ornament; in others the colonies are built up of exquisite little frosted tubes, often gracefully

* The only known exceptions are the members of the genus *Loxosoma*, Keferstein.

curved and delicately tinted, which form the most varied and attractive combinations. But whatever the diversity of external aspect, the internal structure is conformed to one very definite type.

Before proceeding to sketch the general plan of organization amongst the *Polyzoa*, and the various zooidal forms, it will be necessary to define the principal descriptive terms employed.

TERMINOLOGY.

Happily this is comparatively simple, and presents no special difficulty *in limine* to the student. A few terms, which are most of them in general use, are sufficient for all the purposes of accurate scientific description.

ZOARIUM (= *polyzoarium* auctt.).—The composite structure formed by repeated gemmation.

ZOÆCIUM (= *cell* auctt.; *cystid*, Nitsche; *Brutkapsel*, Reichert).—The chamber in which the polypide is lodged.

POLYPIDE (= *polype* of older authors; *bryozoid*, Reichert).—The zooid, consisting of alimentary canal, with tentacles, nervous ganglion, &c., which is developed within the zoæcium.

CÆNÆCIUM (= *polypidom*, Johnston; *polypary* auctt.).—The common dermal system of a colony.

ECTOCYST (= *ectoderm*).—The outer layer of the *cænæcium*.

ENDOCYST (= *endoderm*).—The inner layer of the *cænæcium*.

ENDOSARC (= "*colonial nervous system*," F. Müller;

“*Funicularplatte*,” Nitsche; “*das communale Bewegungsorgan*,” Reichert).—A tissue, derived from the endocyst and composed for the most part of fusiform cells, which constitutes the connexion between the polypides in a colony.

FUNICULUS.—A contractile cord, attached to the base of the stomach of the polypide and passing down to the bottom of the cell: a portion of the endosarc.

PERIGASTRIC CAVITY.—The space between the endocyst (or inner wall) of the zoæcium and the polypide.

LOPHOPHORE.—The frame or stage surrounding the mouth, which supports the tentacles.

COMMUNICATION-PLATE (“*Rosettenplatte*” of Reichert; *communication-pore*, Smitt).—A diaphragm, pierced by one or more minute orifices, occurring in the walls of the adjacent cells amongst the *Cheilostomata*, and between the internodes and at the base of the zoæcia in the *Ctenostomata*, by means of which communication is maintained between all the cells in a colony and between all the compartments of the stolon.

OÆCIUM (= *ovicell* auctt.).—The special receptacle, attached to the zoæcium, in which the ova complete their development into the larva, in many of the *Cheilostomata*.

GONOCYST.—The inflation of the surface of the zoarium, in which the embryos are developed in certain sections of the *Polyzoa*.

GONÆCIUM.—A modified zoæcium set apart for reproductive functions*.

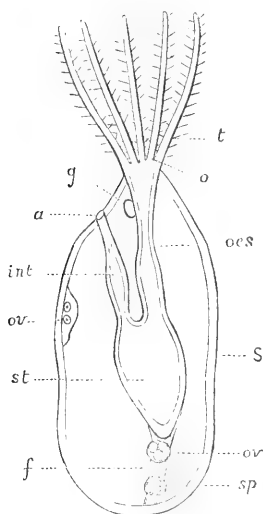
* In the systematic portion of this work, the term *oæcium* is applied equally to the marsupium of the *Cheilostomata*, the modified, reproductive

STOLON.—The creeping tubular stem, by which the individual zoœcia or celliferous shoots composing a colony are held together, in certain members of the class (*e. g.* the *Ctenostomata*).

GENERAL PLAN OF STRUCTURE.

In every polyzoon we distinguish two fundamental elements, the zoœcium and the polypide. These are the

Fig. i.



S. Membranous sac. t. Tentacular crown. o. Mouth. oes. Esophagus. st. Stomach. int. Intestine. a. Anus. g. Nervous ganglion. f. Funiculus. ov. Ovary. sp. Spermary.

primary zooids in every colony. When the larva fixes itself, after its brief term of free life, it is metamorphosed

cell of *Crisia* and other forms, and the superficial inflation of the zoarium in which the embryos are developed in many of the *Cyclostomata*. It is clearly desirable, however, that these very different structures should be distinguished by separate names.

into a single sac or cell *, inclosing a mass of formative material and certain rudimentary elements, out of which a polypide is developed. These two constitute together the primary term of the colony; and by repeated bud-dings, according to the pattern of the species, the composite zoarium is built up. The colony is formed by the indefinite repetition of the primitive zooids and their modifications.

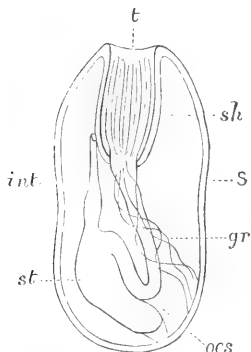
The polypide consists essentially of a tube (alimentary canal) bent upon itself so that its two orifices approximate, one of them (the oral) (Woodcut, fig. i. *o*) being furnished with a number of ciliated tentacles (Woodcut, fig. i. *t*). In the tube or canal distinct regions are recognizable—an œsophagus, stomach, and intestine (fig. i. *œs*, *st*, *int*): on the side of the œsophagus lying nearest to the second of the two orifices (the anal) is placed a nervous ganglion (fig. i. *g*). The alimentary canal, thus constituted, is inclosed in a sac filled with fluid (the *zoæcium*) (fig. i. *S*), which possesses two openings, corresponding with the two extremities of the tube: through one of them the tentacles are expanded; through the other the rejectamenta are expelled (fig. i. *a*). In most of the members of the class the upper or oral extremity of the sac is soft and flexible, and is capable of being inverted (or invaginated) and drawn within the cavity when the polypide retreats into its cell, the inverted portion forming a sheath round the tentacles†

* “La première zoécie, souche de la colonie nouvelle, n'est pas, comme on l'a dit, *engendrée* par la larve. C'est la larve elle-même qui se métamorphose comme la chenille se métamorphose en chrysalide, c'est à dire en conservant son individualité.”—JOLIET, *Bryoz. d. côtes d. France*, page 83.

† This is not the case amongst the *Entoprocta* (*Pedicellina* and *Loxosoma*). nor in *Rhabdopleura*, the polypide of which is quite unattached to its cell.

(Woodcut, fig. ii. *sh*). All but universally* the alimentary canal is furnished with a system of muscles, by means of which it can be partially exerted and retracted.

Fig. ii.



sh. Tentacular sheath (invaginated). *t*. Tentacles. *gr*. Great retractor muscles. *st*. Stomach. *oes*. Œsophagus, doubled up alongside the stomach.

Within the cavity of the cell reproductive organs are developed, in various positions. Heart and vascular system are wanting.

These are the general features of the polyzoan type of structure.

THE ZOËCIUM†.

The zoöcium or cell, the home of the polypide, and one of the elements of which the cœnœcium is composed, is the primary zooid of the colony, and as such is entitled to our first consideration. In its normal condition it is a sac, of variable size and shape, which incloses and protects

* The exceptions here also are the *Entoprocta*, in which the polypide is not retractile and the tentacles are merely rolled up, and *Rhabdopleura*, in which the muscular system is suppressed and the polypide crawls out of its cell by means of a large foot-like organ.

† Ζωόν, animal, and οἶκιον, house.

the alimentary zooid. But the structural type which it represents appears under various modifications, subservient to very different functions, as we shall see hereafter. At present we are to regard it, in its primitive form, as the house of the polypide.

Its walls are made up (with, perhaps, a single exception*) of two membranes, which are perfectly distinct in histological character and in function.

Ectocyst.—The outer (*ectocyst*) is essentially a simple chitinous membrane, without any apparent structure, and is a secretion from the inner layer of the cell-wall (*endocyst*). In a large proportion of cases the ectocyst is strengthened by the deposition of calcareous or siliceous particles, and forms a solid wall, the free surface of which is often curiously sculptured or embossed. In others it retains its primitive membranous character, or is slightly coated with earthy material; in others, again, it is soft and gelatinous. In many forms the calcification of the ectocyst is only partial; and important systematic distinctions are founded on the differences in degree which it exhibits, and the consequent structural peculiarities of the cell.

The Polyzoan colony, as already remarked, consists of a larger or smaller number of zoœcia variously united together, which are produced by repeated gemmation. Buds are given off from the primary cells, which are soon developed into secondary cells; and from these again others arise. In the same way every successive zoœcium multiplies itself; and the cœnœcium continues to enlarge so

* According to Allman, the freshwater genus *Cristtaella* is destitute of an ectocyst. Hyatt, however, regards it as possessing one, and describes it as "a transient gelatinous excretion" (*op. cit.* page 14).

long as the vital energies are unexhausted. But the cells are not mere isolated chambers placed side by side and connected one with the other as portions of a continuous structure, like the bricks in a house, but are united in a much more intimate and vital way. Their soft contents are in direct connexion no less than their external surfaces; and as the structure by means of which this connexion is maintained belongs to the system of the ectocyst, it may be noticed here.

In the outer wall of the cell (amongst the *Cheilostomata*) certain spaces are met with in various positions, which are composed of thinner material than the rest of the ectocyst, and are pierced by one or more very minute perforations (Woodcut, fig. iii. *cp*). These thin perforated

Fig. iii.



Membranipora membranacea.—Wall of zoecium.

cp. Communication-plates.

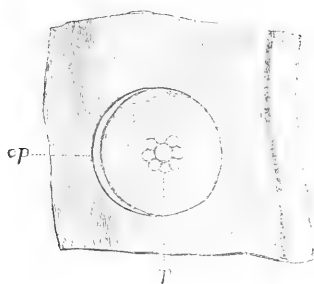
plates occurring in the cell-wall have been named by Reichert "*Rosettenplatten*"*; but as this term cannot be very aptly rendered into English, I shall distinguish them as *communication-plates*. Amongst the *Ctenostomata* we find their equivalent in the diaphragms closing the cells at their base, and separating the internodes of

* "*Vergleichende anatomische Untersuchungen ü. Zoobotryon pellucidus*, Ehrenberg, von Karl B. Reichert," *Abhandl. d. königl. Akad. d. Wissenschaften zu Berlin*. 1869, p. 267.

which both the creeping stolon and the erect stems are composed. Through the minute orifices in these plates thread-like prolongations of the endosarc pass, and establish a connexion between all the polypides in the colony.

The communication-plates vary in number, position, and form; they are furnished either with a single central foramen* or with several minute pores arranged in different ways (Woodcut, fig. iv.). According to Nitsche†, in

Fig. iv.



Zoobotryon. —Portion of stem.

cp. Communication-plate. p. Pores.



the common *Membranipora membranacea* each normal zoæcium has generally twelve of these plates—two at each extremity, and four in each side-wall. Those belonging to each zoæcium correspond with others in the adjacent walls, so that the connecting-threads can pass directly from cell to cell. Every zoæcium in this species has two openings into each of the six cells which abut upon it.

Mr. Waters has drawn attention to the communication-plates as likely to afford good diagnostic characters,

* As in *Bowerbankia imbricata*, according to Joliet, 'Bryozoaires d. côtes de France,' p. 31, note.

† 'Beiträge zur Kenntniss der Bryozoen,' ii. Heft: "Ueber die Anatomie u. Entwicklungsgesch. von *Flustra membranacea*," Zeitsch. f. Wissensch. Zool. xxi. Band (1871). 4. Heft, p. 42.

especially for the determination of fossil forms; and no doubt they may be available to some extent, chiefly in cases in which the salient characteristics of the cell have been more or less obliterated. Otherwise the difficulty of examining them must always limit their use in ordinary diagnosis.

Nitsche, in his interesting monograph on *Membranipora membranacea*, has pointed out a modification in the structure of the ectocyst in this species by which it is adapted to its usual habitat. The cœnœcium is not a continuous stony framework, but in every zoœcium certain sections only of the wall are calcareous, and between these are interposed uncalcified and flexible plates. In this way the whole cell is rendered flexible, and consequently the whole colony, composed of thousands of cells; and instead of breaking up as the great Laminarian fronds in which it delights sway backwards and forwards in the water, the living lacework adapts itself to their undulations and escapes destruction. So far as function is concerned, these flexible plates may be compared, as Nitsche has already remarked, with the corneous joints in the stems of many of the erect and branching *Polyzoa*.

The ectocyst, then, or external layer, is a mere structureless excretion from the endocyst, charged with a protective function, but with no special physiological significance.

We pass on to a much more important element of the structure, the *endocyst* itself, or internal layer of the cell-wall.

ENDOCYST.—This presents itself under somewhat different forms in the *Gymnolæmata* and *Phylactolæmata* (or

freshwater Polyzoa), amongst the *Ectoprocta*, and in the group of the *Entoprocta*. As this work does not include the *Phylactolæmata*, I shall confine myself at present to an account of the endocyst as it exists amongst the other sections of the class.

First, then, in the marine *Ectoprocta* the endocyst appears in the adult cell as a delicate transparent membrane, without any cellular structure, a layer of simple protoplasm, lining the ectocyst throughout, and generally lying close upon its inner surface*. But though it occurs in this condition in the older regions of the cœnœcium, it is essentially a cellular membrane; and its true nature may be readily determined by the study of the growing extremities of a branch or stolon amongst the *Ctenostomata* (for instance), which offer the greatest facilities for investigations of this kind. Here, according to Joliet, the endocyst appears as a very thick layer, and exhibits a distinctly cellular structure. He describes it as composed

* I may say here once for all that I do not propose to enter into minute histological detail. The space at my command would not allow of my doing so; and, apart from this, such detail would be out of place in a general sketch like the present.

On the structure of the endocyst the reader may consult:—SMIT, "Om Hafs-bryozoernas Utveckling och Fettkroppar," (Efv. Kongl. Vet.-Akad. Förh. 1865, no. 1, p. 16; CLAPARÈDE, Zeitschr. f. wiss. Zool. xxi. p. 142; NITSCHÉ, "Ueb. *Flustra membranacea*," Zeitschr. f. wiss. Zool. xxi. Heft 4, pp. 44-46; REICHERT, "Vergleich. anatomische Untersuchungen üb. *Zoothotryon pellucidus* (Ehrenb.)," Abhandl. königl. Ak. d. Wissensch. zu Berlin, 1869, p. 270; JOLIET, 'Bryoz. d. côtes de France,' pp. 56-58, and p. 65; EHLERS, "*Hypophorella expansa*, ein Beitrag zur Kenntniss der minirenden Bryozoen," Abhandl. königl. Gesellschaft d. Wissenschaften zu Göttingen, xxi. 1876, p. 27 (sep.). In the *Entoprocta* specially:—NITSCHÉ, "Ueb. die Anatomie von *Pedicellina echinata*," Zeitschr. f. wiss. Zool. xx. Heft 1, p. 18; SALENSKY, "Études sur les Bryoz. Entoproctes," Ann. Sc. Nat. sér. 6, Zool. vol. v. art. no. 3; JOLIET, *op. cit.* p. 61. In the *Phylactolæmata*:—ALLMAN, 'Freshwater Polyzoa,' p. 11; HYATT, "Observations on Polyzoa, suborder Phylactolæmata," Proc. Essex Inst. vols. iv. & v. 1866-68, p. 26; JOLIET, *op. cit.* p. 59.

of conical cells placed closely together, their basal surfaces turned towards the ectocyst and forming an irregular mosaic work, whilst their opposite pole is directed towards the centre. These cells possess a distinct nucleus, and are very refractive.

Amongst the *Ectoprocta* (*Pedicellina*, &c.) the endocyst consists of a layer of polygonal cells, with strongly refractive oval nuclei, which lies close upon the inner surface of the ectocyst. In this division its cellular character is distinguishable at all points, though it is more clearly and strongly marked towards the upper extremity of the peduncle*.

As to the specific functions of the endocyst, it has been held that it gives origin directly to all buds formed within the cœnœcium, and to the generative products of both kinds†. According to this view, it is the source of the polypide, and of both the ovary and spermary. A different rôle, however, has been assigned to it by the able French biologist Joliet; and it will be necessary to consider somewhat in detail the very important conclusions to which his researches have led him. It will be more convenient, however, to do this hereafter; and I shall merely state generally at present that he regards the endocyst as specially charged with the enlargement of the colony, and also as giving origin to a distinct tissue, which he names (provisionally) the *endosarc*, to which are really assignable the functions hitherto credited to the endocyst, and others beside.

Connected with the endocyst is an apparatus of

* Joliet, *op. cit.* p. 61.

† Nitsche, "Ueb. die 'Morphologie d. Bryozoen.'" *Zeitsch. f. wiss. Zool.* xxi. Heft 4, p. 102.

muscles, which plays an important part in the economy of the Polyzoon, and which may be noticed here. It consists of a number of short transverse fibres or bundles of fibres, which pass from point to point on the surface of the inner wall of the cell, and which by their contractions are instrumental in compressing the membrane and so reducing the dimensions of the perivisceral cavity. In this way pressure is brought to bear on the contained fluid, and a force is generated which discharges, as we shall see hereafter, a most essential function. These fasciculi are known as the *parietal muscles*.

We are to conceive, then, of the zoœcium as a chamber inclosed by a more or less solid outer wall, and within lined by a soft tapestry of living membrane, a well-built and well-furnished dwelling, of which the polypide or alimentary zooid is the tenant.

THE POLYPIDE.

The general plan of the structure has been already sketched. In examining the details it will be necessary to take the two great divisions of the Polyzoa (the *Ectoprocta* and *Entoprocta*) separately.

For a detailed account of the freshwater members of the former group (*Phylactolæmata*), I may refer to the writings of Allman*, Van Beneden†, Hancock‡, Hyatt§,

* 'Monograph of the Freshwater Polyzoa,' Ray Society, 1856.

† "Recherches sur les Bryozoaires fluviatiles de Belgique," Mém. Ac. Roy. Belg. xxi. 1847; (Dumortier and Van Beneden), 'Hist. Nat. des Polypes composés d'eau douce, 2^e partie : complément au tome xvi. d. Mém. de l'Acad. Roy. Brux. 1848.

‡ "On the Anatomy of the Freshwater Bryozoa," Ann. & Mag. Nat. Hist. March 1850.

§ "Observations on Polyzoa, suborder Phylactolæmata," Proc. Essex Inst. 1866-68.

and Nitsche*; they lie without the limits of the present work.

The structure of the polypide as it occurs in the ordinary marine forms may be considered under the following headings:—i. the tentacular crown and sheath; ii. the alimentary canal; iii. the nervous system; iv. the muscular system.

TENTACULAR CROWN AND SHEATH.—The tentacles form a bell-shaped wreath, which is borne on a kind of circular stage (the *lophophore*), occupying the summit of the body, and perforated in the centre by the mouth. They are ranged round the circumference of the lophophore, which constitutes at once the floor of the tentacular bell and the roof of the perigastric cavity, lying immediately below it. The mouth is a simple round orifice, opening into the œsophagus, and so placed as to form the focus towards which the supplies of food drawn in by the ciliary vortex converge. The slender filiform tentacles are tubular, closed at the free extremity, and opening at the base into the perigastric cavity †, or space interposed between the wall of the cell and the body of the polypide, from which the nutritive fluid is freely admitted to them. They are furnished with vibratile cilia, which are ranged in a single line along the two opposite sides, and by their rapid and incessant movement, when the polypide is expanded, create a very maelstrom in the water, which sweeps the

* "Beiträge z. Anat. u. Entwicklungsgesch. d. phylactolem. Süßw. Bryoz.," Archiv f. Anat. u. Physiol. 1868. Sep. Abdr. "Ueb. die Knospung der Polypide der phylactolæmen Süßwasserbryozoen," Zeitsch. f. wissensch. Zool. xxv. Suppl. Bd. Heft 3, 1876.

† There seems to be little doubt that this is the case, though Reichert describes the cavity of the tentacles in *Zoobotryon* as being in communication by means of minute orifices with that of the œsophagus.

passing animalcule or the floating food-particle towards the central mouth. An examination of the structure of the tentacle shows us on each side a layer of cells, furnished with a large and brilliant nucleus; and from these the cilia originate as a simple extension of the cell-wall. (Woodcut, fig. v.)

Amongst the *Gymnolæmata* the tentacles are always disposed in a circle; in the *Phylactolæmata* they range in a continuous series round a crescentic lophophore. In the *Entoprocta* the arrangement is somewhat obscurely bilateral; whilst in the aberrant group of the *Pterobranchia* they are borne in discontinuous series on two lateral processes of the lophophore. They are very variable in number, ranging from eight (which seems to be the minimum) to eighty in some of the freshwater forms. Their movements are rapid and energetic; they can be bent hither and thither; they strike with vigorous percussive action; they can be instantaneously coiled into a spiral, and as suddenly unrolled. They assist the ciliary currents, by their varied movements, in obtaining food, and help to keep off unsuitable or injurious matter.

But they are not only concerned with the direct nutrition of the polypide; they have also a distinct respiratory function. The ciliated tentacles of the Polyzoa * are, no

Fig. v.



Ciliary cell
of
Fredericella.
n. Nucleus.

* "Gill-filaments" (Ray Lankester), identical with "the gills and labial tentacles of the Lamellibranchia and the spiral arms of the Brachiopods." See "Notes on Embryology and Classification," Quart. Journ. Micr. Soc. new ser. no. 68, 1877, p. 423.

doubt, largely instrumental in promoting the aeration of the fluids which enter them freely from the perigastric cavity. They must also be regarded as tactile organs, and in many species are furnished with special appendages, by which their sensitiveness and power of detecting the presence of minute particles are largely increased. They are (as Hyatt has remarked*) "the only means possessed by the polypide of receiving impressions from without."

The energetic movements of which the tentacles are capable would lead us to expect an efficient service of muscles in connexion with them. In *Laguncula* (*Farrella*) Van Beneden describes muscular fibres in each arm; he also detected delicate bands in the freshwater group which he regards as of the same nature. Hyatt has demonstrated two sets of "tentacular bands," an outer and an inner, in each arm, which are in connexion with muscles running through the lophophore, and control the movements—the external bands inclining the tentacle outwards or sideways, the internal bending it towards the centre of the lophophore. This observation has been confirmed by Nitsche, who finds in the tentacles a pair of fasciculi, each of which consists of two or three long fibres.

In the tentacles of *Membranipora membranacea* and of *Pedicellina* the latter author has noticed obscure traces of muscular structure; those of *Loxosoma*, according to Vogt, show no indication of it.

* *Op. cit.* p. 47. The polypides (according to this author) are not sensitive to light. "At ordinary temperatures even the darkness-loving *Fredericella* may be exposed for a time to the direct rays of the sun without any visible result, although but just removed from the perpetual shade in which it had previously lived."

The TENTACULAR SHEATH is an important element of the structure, and a very characteristic feature of the ordinary Polyzooan type (Woodcut, fig. ii. *sh*). It is a membranous extension of the anterior part of the zoëcium, which, when the polypide is retracted, is inverted and drawn in with it, closely surrounding the folded tentacles. According to some writers * it is wholly composed of the endocyst; but Joliet refers it to the tissue which he has named the endosarc, of which an account will be given hereafter. The invagination of the sheath is due to its attachment at its upper extremity round the base of the crown of tentacles; as the latter descends in obedience to the summons of the retractor muscles it is, of course, drawn down with it, and reversed as the finger of a glove might be under similar circumstances, forming a protective case around it, which somewhat exceeds it in length. By this arrangement the zoëcium is completely closed; there is no real opening through which the polypide passes. It is the upward movement of the tentacular corona (to be explained hereafter) which carries with it and everts the flexible sheath, and so permits the imprisoned zooid a certain amount of communication with the outer world; but the cavity of the cell itself is sealed. The movements of the polypide in the acts of expansion and retraction are limited to the eversion and inversion of the sheath; and only the corona is brought into immediate contact

* Allman and Nitsche. Ehlers, however (*op. cit.* p. 37), considers that both ecto- and endocyst enter into its composition, though the former is (in many species) less solid in this portion of the structure than in the rest of the outer wall of the cell. Joliet holds that the tentacular sheath is a derivative from the endosarc (see page xxxv), and not an invaginable portion of the endocyst. He describes it as of the same nature as the funiculus, resembling it in its mode of development, in its contractility, and in its histological elements (*op. cit.* pp. 51, 52). I am inclined to think that this may prove to be the true account of it.

with the surrounding water. In the sheath muscular fibres, both longitudinal and transverse, occur; and the latter form a broad sphincter at a short distance from the base of the tentacles.

By "the orifice" of the zoecium is meant the opening through which the tentacular sheath and the corona are protruded. Of course it is not an opening in the sense of a passage giving access to the interior of the cell; it is the break in the more or less solid portion of the wall through which the evaginable part of the zoecium is pushed forth; and by this and the tentacular corona it is permanently closed. The orifice exhibits some remarkable structural peculiarities, correlated with other important characters; and these have been happily employed by Mr. Busk in the definition of some of the leading systematic groups. They will be referred to more particularly in the section on Classification. (See Woodcut, fig. 35, p. 562.)

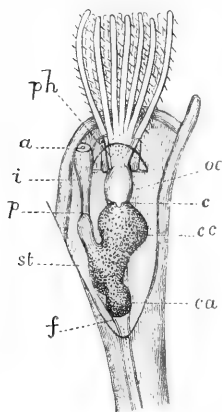
ALIMENTARY CANAL.—The plan of the digestive system amongst the Polyzoa, though very constant in its leading features, presents many variations in detail. I shall first describe its essential parts, and then refer to some of its more striking modifications.

Three well-marked regions are distinguishable in the alimentary canal—the œsophagus (including the pharyngeal cavity, which is more or less strongly defined in different species), the true stomach (or digestive sac), and the intestine.

The mouth, a simple orifice, pierced in the floor of the tentacular crown, opens at once into the upper part of the œsophagus, which is thickly clothed with vibratile cilia, by whose action the food drawn in by the tentacular vortex

is forced down into the tube, and brought well within the range of its peristaltic movements. The upper extremity of the œsophagus is frequently organized as a distinct pharynx (Woodcut, fig. vi. *ph*), a wide, funnel-shaped

Fig. vi.

*Polypide of Bugula plumosa.*

ph. Pharynx. *oe.* Œsophagus. *c.* Cardia. *cc.* Cardiac cavity. *st.* Stomach.
ca. Cæcal appendage. *i.* Intestine. *p.* Pylorus. *a.* Anus. *f.* Funiculus.

chamber, with muscular walls, capable of vigorous contractions, within which the particles of food collect, and from which they are hurled down the œsophageal tube at intervals into the stomach.

The surface of the pharynx appears to be dotted over with minute spots (Woodcut, fig. vi. *ph*) ; down one side of it runs (in many cases, if not universally) a band, which is crossed by transverse striæ, and which is very conspicuous from the contrast it presents to the rest of the structure. It also attracts attention from its vigorous movements, which are connected with the expansion and contraction of the pharynx. There can be no doubt that

we have here (as Dr. Farre has suggested) a special muscular apparatus, by which the action of this organ is regulated. The pharyngeal cavity, in such cases, must be regarded as playing an important subsidiary part in connexion with the nutritive system. Here the particles of food gather in the first instance, and, it would seem, are submitted to some kind of selective process: when a sufficient amount of suitable material has collected, the constriction at the base of the canal is relaxed, and the food passes rapidly, impelled by the pharyngeal spasm, and subsequently by the peristaltic movements of the œsophagus, to the stomach. In other cases, the pharynx is not so clearly defined, and the oral region of the œsophagus is chiefly distinguished from the rest by its ciliated lining.

The œsophagus varies much in length in different species*: it is usually a straight and slender tube, which leads directly into the digestive sac. In the course of this tube is placed a valve (the cardia), marking the entrance to the stomach, and consisting of a conical perforated projection, with the free extremity directed downwards, which opens for the passage of the food, but is otherwise closed, and forms a barrier preventing its return into the œsophagus (Woodcuts, figs. vi. & ix. c).

The position of the cardia varies in different species; it is sometimes placed high up in the œsophagus, and sometimes much lower down and close to the true stomach. In *Beania mirabilis* (Woodcut, fig. vii.) I can detect no separation between the stomach and the œsophageal region but the constriction which closes the funnel-shaped

* Compare Woodcuts, figs. vii. and vi. In the former (*Beania mirabilis*) it is of remarkable length; in the latter (*Bugula plumosa*) it is almost rudimentary.

pharynx; and in this case the dark-coloured hepatic cells range for some distance above the stomach on the walls of the tube, the lower part of which may therefore be regarded as in some sense an extension of the digestive sac (=the "cardiac cavity").

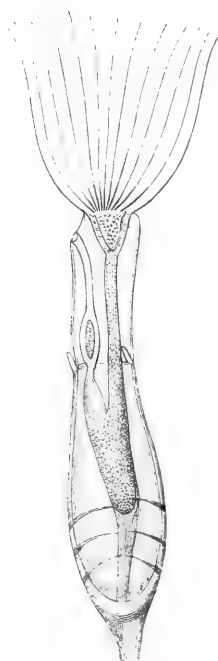
In the œsophagus transverse striæ are distinguishable, which are muscular in character; and to their action in compressing the walls the peristaltic movements are due*.

The stomach, in its simpler form, is a sac or bag, with rather thick walls (Woodcuts, figs. i. & viii. *st*), often wide above, and more or less pointed below; sometimes elongate and almost cylindrical in shape. It is coloured a rich yellowish brown, the colour being due to the presence of numerous glands on its inner or lining membrane, which secrete a brown fluid, and probably discharge the functions of a liver; this fluid mingles freely with the contents of the stomach, and imparts its own colour to them†.

* Hyatt, *op. cit.* p. 48.

† According to Vogt, these cells are not only biliary in function, but also act as absorbents. In polypides (of *Loxosoma*) that had been fed with carmine, he has seen them assume an orange or scarlet tint, showing that there had been an absorption of the colouring-matter, which had modified the ordinary amber-yellow of the cells. — "Sur le *Loxosome* des *Phascosomes*," *Archives de Zoologie expérimentale*, 1877.

Fig. vii.



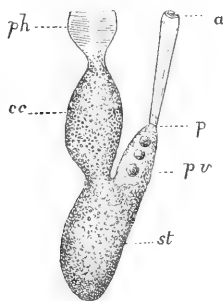
Beania mirabilis.

The walls of the true digestive sac, like those of the œsophagus, are furnished with transverse muscular fibres, by means of which the vigorous peristaltic movement, which plays so important a part in the digestive process, is secured.

From the upper part of the stomach, and near the point where the œsophagus or the cardiac cavity (as the case may be) rises from the main digestive sac, the intestine (Woodcut, fig. i. *int*) takes its origin, and passes upwards, terminating in an orifice which opens out through the tentacular sheath at a short distance (Woodcut, fig. vi. *a*) from the base of the corona*.

Near the lower extremity of the intestinal tube is placed

Fig. viii.



Alimentary canal of Cellepore.

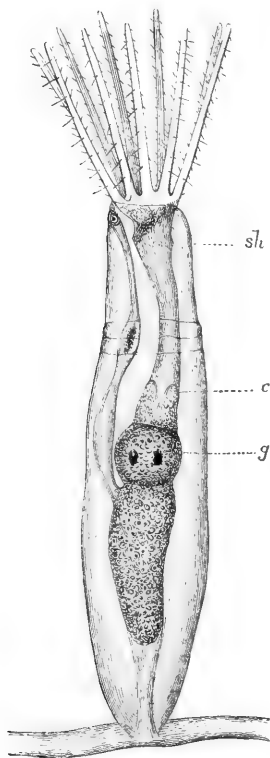
ph. Pharynx. *cc.* Cardiac chamber. *st.* Stomach. *pv.* Pyloric vestibule.
p. Pylorus. *a.* Anus.

the pyloric valve, which regulates the admission of the rejectamenta into it. Sometimes the valve is borne on

* The position varies: in some cases the anal opening is situated much lower down on the side of the zoecium; in *Alcyonidium gelatinosum* it is represented by Farre as occurring at the base of the setose operculum—that is, about halfway down the cell.

the summit of a somewhat tubular extension of the stomach (Woodcut, fig. viii. *pv*), which forms a kind of vestibule to the intestine, and is richly clothed with cilia. Into this space, which may be distinguished as the *pyloric vestibule*, the indigestible elements of the food are gradually gathered; and here they are formed by the action

Fig. ix.

*Bowerbankia*.—*g*. Gizzard. *c*. Cardia.

of the cilia into pellets, which are kept in rapid rotation, and ultimately pass into the intestine. In other cases (as in *Bowerbankia*, Woodcut, fig. ix.) the intestine

is continued to the digestive sac, and the pylorus is situated at the point of junction between the two. Amongst the marine Polyzoa the portion of the inner wall of the stomach which abuts upon the pylorus is always clothed with cilia.

The intestine varies much in form : in some cases it is a long and slender tube (Woodcut, fig. vii.), with perhaps a slight dilatation at one point ; in others it is short, wide below, and narrowing towards the upper extremity ; in others, again, it expands into two distinct chambers—one placed a little above the point of origin, and the other (rectum) a little below the anus. The excreta are retained for some time in the intestine, and, as Allman has remarked, probably yield to the absorbent tissues their remaining nutritious elements ; they are subsequently expelled through the terminal orifice.

Apart from the variations already referred to, there are one or two important modifications of the digestive system which must be noticed. In some species a globular organ is interposed between the œsophagus and the stomach, which exhibits a highly specialized structure, and discharges the functions of a gizzard (Woodcut, fig. ix. *g*). It is an enlargement of the cardiac portion of the stomach, the walls of which are here much thickened, and furnished with a powerful apparatus of muscles. The inner surface of the cavity is lined in part by a number of pointed processes (gastric teeth) ; and by means of these and the vigorous contractions of the muscular wall the food is crushed, as in a grinding mill, and then delivered to the stomach to be treated with the biliary secretion and exposed to the roll of its peristaltic movements. This organ in its fully developed form is only met with in

one section of the Polyzoa, the *Ctenostomata*, of which the well-known *Bowerbankia* is a characteristic example (Woodcut, fig. ix.). We find its equivalent, however, in many of the *Cheilostomata*. This consists of a prolongation of the stomach upwards in the line of the œsophagus, extending to the cardia, which is placed high up in cases in which this appendage is largely developed. (Woodcuts, figs. vi. & viii. cc.) In the former of these figures, representing the polypide of *Bugula plumosa*, this cardiac chamber appears as a globular dilatation, occupying the lower portion of what in other species would be the œsophagus; in the latter (*Cellepora*) it is elongate-oval in form, and extends from the base of the intestine to the pharynx. In this case the œsophagus is reduced to the pharyngeal cavity, while the stomach is proportionately enlarged. The walls of the cardiac chamber are thickly covered by the hepatic glands. We must, I think, recognize in this structure the homologue of the gizzard, whose place it fills.

In some species a peculiarity is noticeable in the lower portion of the digestive sac. The extremity of the cæcum is separated from the rest of the stomach by a narrow passage or channel, and has the appearance of a distinct chamber suspended below it (Woodcut, fig. x.). This cæcal appen-

Fig. x.

*Bicellaria ciliata.*

Lower part of stomach.
ca. Cæcal appendage.

dage is formed, according to Joliet, by a thickening of the walls of the stomach at a certain point. It shares in the vigorous peristaltic movements of that organ; the food is carried into it from above, and then forcibly driven back into the upper compartment. This appen-

dage is very conspicuous in the common *Bicellaria ciliata* ; I have also noticed it in *Bugula*. There is nothing in the structure to indicate that it differs physiologically from the rest of the sac. It may possibly have a merely mechanical function in promoting and assisting the constant flux and reflux of the food within the digestive cavity.

Specialization reaches its height in the digestive system of such forms as *Bowerbankia* and *Bugula*, and its minimum probably in that of *Eucratea* and *Valkeria* (Woodcut, fig. 33, p. 550) ; and between the two extremes there lies a rather wide range of structural difference. In the latter we have a perfectly simple condition of the various parts, and the process of digestion is effected, so to speak, by a small number of agents.

The details of the digestive process may be studied to the greatest advantage in many of the Polyzoa, the walls of the cell being often so transparent as to permit the most thorough investigation of all that is passing within. In the pharyngeal chamber (where this is differentiated) the particles of food gather and are sifted ; when a certain quantity has accumulated, it is forcibly ejected into the œsophagus, and hurried downwards by the contractions of the tube into the stomach. Lodged in the true digestive sac, it comes under the influence of the strong peristaltic action of its muscular walls, and is driven to and fro by its incessant sweep with a kind of rhythmical regularity throughout the length of the cavity. While this mechanical treatment is in progress, the biliary glands pour in their secretion and the food takes on its rich brown colour. At the same time the indigestible elements are gradually eliminated and gather near the pyloric orifice, where they are kept rotating for a while by the action of

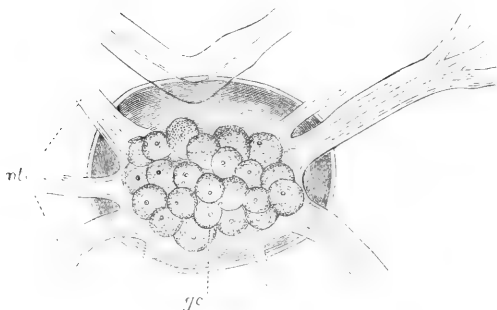
cilia, and gradually pass into the intestine. Where a gizzard is present, the food is crushed in its passage through it and delivered half prepared to the stomach*.

NERVOUS SYSTEM.—This is present under a very simple and rudimentary form. It consists (amongst the marine forms) of a single roundish or oval ganglion, placed against the wall of the œsophagus, towards its upper extremity, on the anal side (Woodcut, fig. i. *g*), from which sets of nerves are given off in different directions. The latter it is exceedingly difficult to follow; and in many cases they elude observation altogether. Allman, however, succeeded in detecting, in some freshwater species, a nerve-trunk running through the lophophore, and sending off filaments towards the tentacles, and also a filament passing off from the nerve-centre to the œsophagus. The details of the nervous system amongst the *Phylactolæmata* have been more thoroughly worked out by Hyatt and Nitsche, who have confirmed Dumortier's observation of the union of two ganglionic centres in the nerve-mass in this division. These are united by a commissure, and each of them supplies the nerves to its own side of the body. Nitsche has also demonstrated the existence of a narrow collar encircling the œsophagus. Hyatt describes, with some minuteness, the distribution of the nerve-trunks and branches which supply the lophophore and probably the tentacles (though no filaments are to be traced into them), the tentacular sheath, and the various portions of the alimentary canal. The more delicate nervous filaments he was unable to define.

* I have seen the food, after passing through the gizzard, driven back into this organ by the contractions of the stomach, and again submitted to its action.

Generally there is extreme difficulty in making out the details of the system in the marine forms. In *Membranipora membranacea* Nitsche has only detected mere rudiments of nerve-trunks, on the surface of the ganglion. Ehlers has done the same in *Hypophorella*. In *Loxosoma* Salensky has traced various filaments to the tactile organs on the sides of the body*; whilst Nitsche has described three nerve-trunks as given off on the opposite sides of the ganglion in *Pedicellina*, which soon divide and supply the tentacles (Woodcut, fig. xi.). Two of smaller size were also observed passing from the

Fig. xi.



Ganglion or Nervous centre.
nt. Nerve-trunks. *gc.* Ganglionic cells.

anal surface towards the reproductive organs. The ganglion itself consists of a solid membranous envelope, inclosing a mass in the outer region of which no structure is distinguishable, but which is made up towards the centre of large cells with granular contents and a nucleust†.

* "Études sur les Bryozoaires Entoproctes," Ann. d. Sc. Nat. 6^e sér. Zool. vol. v. (1877), Article no. 3, pls. xii.-xv.

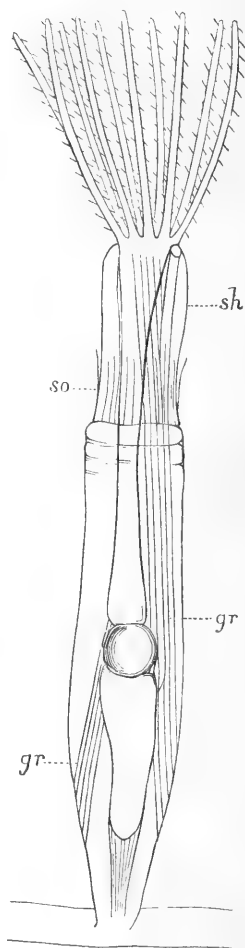
† Nitsche, "Ueber die Anatomie von *Pedicellina echinata*," Sars, Zeitsch. f. wissensch. Zool. xx. Heft 1, p. 28.

Of the tissue described by Fritz Müller as a common or "colonial" nervous system, an account will be given hereafter.

MUSCULAR SYSTEM.—This is largely developed amongst the Polyzoa, and exhibits a high degree of complexity. Nor will any one be surprised at this who has observed the rapid and varied movements of the polypide and the curious mechanism of the cell. For the mere act of retraction a whole apparatus of muscles is required; and, in addition to this simple movement, the remarkable mobility and varied play of the corona as a whole, and of the individual tentacles, involve a special service. The opercular mechanism demands a distinct set of muscles; another is needed to assist in the withdrawal and stowage of the alimentary canal, another to steady it and hold it in its place when extended, and yet another to secure the contractility of the inner wall, on which the protrusion of the polypide is largely dependent. In addition to all these claims, the various regions of the digestive system must have their own supplies of contractile tissue to enable them to discharge their respective functions efficiently. The power of rapid retreat is essential to the safety of the polypide; and hardly less essential is the perfect mobility of the tentacular wreath; and no one can have watched a living colony without seeing how admirably these are provided for. At the slightest alarm the exquisite bells collapse and vanish on the instant. When the polypide is expanded and in quest of food the corona can be swayed in every direction, and each of the tentacles composing it can be brought into varied and vigorous action.

Into the details of the muscular apparatus, upon which these and the other movements of the polypide depend, it is not my purpose to enter here*; but one or two of its leading elements may be noticed. The largest and most powerful of the muscular bands in the cell of the Polyzoon are the *great retractors* (Woodcut, fig. xii. *gr.*). These consist of two broad fascicles, which are attached to the lower part of the cell-wall and extend upwards to the base of the tentacles, where they are inserted into the sides of the œsophagus. When the polypide is expanded, they extend as two (apparently) solid bands throughout the greater part of the length of the cell; suddenly contracting, they drag down the corona with the speed of light, inverting the tentacular sheath (doubling up the alimentary canal at the same time on itself), bringing all the parts into the shelter of the cell, and disposing the whole structure in orderly fashion within its cavity. In these large bands we can study to the greatest advantage the structure of the muscular tissue.

Fig. xii.

*Bowerbankia.*

* Full accounts of the different sets of muscles and of their respective action may be found in the works of Farre (Phil. Trans.), Van Beneden (on *Laguncula*), Allman (Freshwater Polyzoa), Hyatt (*op. cit.*), Nitsche (on *Membranipora membranacea*), &c.

The band which, when in a state of tension, seemed to be solid, is found, when relaxed, to be made up of a number of separate fibres. Complex as the muscular system of the Polyzoa is, the individual muscle is universally of the simplest and most rudimentary kind—a bundle of distinct threads; it never presents the consolidated form which exists in the higher animals. In the large muscles the fibres appear (under favourable circumstances) transversely striated (Woodcut, fig. xiii.). When the muscular band is at rest, the threads which compose it

Fig. xiii.

separate and lie crumpled up within the cell. Two sets of muscles (the *parieto-vaginal*) are concerned in regulating the action of the invaginated sheath, and pass from the cell-wall to various points on its surface. A powerful *sphincter* closes the sheath after the retraction of the polypide, and keeps all safe within.

The *parietal muscles*, which contract the inner layer of the cell-wall, as well as those which control the tentacles and the peristaltic movements of the alimentary canal, have been previously noticed. For further detail I must refer to the writers already cited.



Striated muscular fibre.

The mode in which the retraction of the polypide is effected will be sufficiently evident from the foregoing hasty sketch of the muscular mechanism of the cell. But the act of protrusion requires a more detailed explanation. It will be borne in mind that the polypide is suspended from the lophophore, and hangs free within the cavity of its cell, bathed on all sides by the perivisceral fluid. When the want of food or oxygen compels it to issue from its

dwelling, the parietal muscles (see page xiii) are at once brought into play, and contract the endocyst or lining membrane, thus reducing the perigastric space, and compressing the fluid, which immediately begins to act on the body of the polypide, and to force it upward in the direction of the orifice*. As it rises, under the influence of this pressure, the sphincter which guards the entrance gives way, and the tentacular pencil passes outwards. Then the parieto-vaginal muscles relax their hold on the inverted sheath, and permit it to follow the course of the advancing corona. The wall-muscles maintain their tension, and keep up a constant pressure from below; steadily and rapidly the ascent continues, the alimentary canal unfolding the while, until, the sheath being fully evaginated and the tentacles freed from restraint, the exquisite bell suddenly expands and the cilia start into play.

Although there can be no doubt that the parietal muscles are thus the great agents in effecting the protrusion of the polypide from its cell, I am quite inclined so far to agree with Dr. Farre as to hold that a certain subsidiary part is played in the process by the muscular walls of the alimentary canal itself; that it cooperates to some extent with the mechanical action of the compressed fluids.

* "These fibres [the parietal] were distinctly seen to contract whenever the protrusion of the animal took place, and to become relaxed again upon its retiring into its cell, the walls of the latter being so pellucid that the minutest alteration in the form of these muscles was readily seen."—FARRE.

The contraction of the cavity of the cell, which takes place during the expansion of the polypide, is very apparent in such Ctenostomatous forms as have a yielding membranous area on one side of the zoœcium. In *Mimosella*, for instance, when the polypide issues, this portion of the cell-wall is drawn inwards, and a distinct cleft is formed; on its return it fills out again, and its presence is with difficulty detected.

THE PERIGASTRIC CAVITY.

The space intervening between the outer wall of the alimentary canal and the inner wall (or endocyst) of the cell is known as the perigastric cavity. It is filled with a colourless fluid, in which a large number of floating corpuscles of various size and shape are always present, and which at certain times swarms with active spermatozoa. Within this cavity the reproductive organs, both male and female, are located; and here the ova pass through certain stages of their course, or, in many cases, complete their development into the larva.

Great interest attaches to the various questions relating to the precise nature and physiological import of the perigastric fluid, which bathes continually the body of the polypide and the tissues which line the cell. In the absence of any direct analysis, it may be presumed that it consists of water more or less charged with the products of digestion*, and that it is subservient to the functions of respiration and nutrition. But it is equally difficult to determine precisely how the water finds access to the closed sac, and how the chyle escapes into it from the stomach. As to the first point, no orifices have been detected through which the water might pass into the interior of the cell, if we except the one for the escape of the ova in *Farrella*, described by Van Beneden, and the "intertentacular organ," investigated by Dr. Farre and myself, which occurs only in a limited number of species, and not constantly in these.

* Reichert has made a rough analysis of the fluid contained in the internodes of the stem of *Zoobotryon*, and finds it to be a somewhat concentrated solution of common salt (like the water of the Adriatic, where the species was obtained), with traces of an albuminous substance (Abhandl. d. königl. Akad. d. Wissensch. zu Berlin, 1869, physikalische Klasse, p. 268).

Hyatt supposes that the entire endocyst may be pierced to a greater or less degree by aquiferous pores, but admits that he had sought for them in vain. Allman suggests (as an alternative explanation) that the water may transude through the walls of the alimentary canal into the cavity of the cell*. It cannot be said that we have any real knowledge on the subject.

As to the second point, it appears all but certain that the products of digestion must mingle to some extent with the perigastric fluid, as there seems to be no other way in which they can be utilized for the benefit of the whole organism. And this fluid being in immediate contact with so large a portion of the tissues, is clearly indicated as the medium through which the nutritive material is supplied to them. But if we inquire how the transference from the stomach to the outer sac is effected, we can get no further at present than the hypothesis that the aliment may transude through the walls of the digestive canal.

The perigastric fluid is admitted freely to the interior of the tentacular tubes, where, as in a system of gills, it is aerated by the water, which is constantly renewed by the ciliary currents. Amongst the freshwater Polyzoa the surface of the endocyst is lined by a ciliated epithelium, which keeps the fluid in constant movement and maintains a very regular circulation. But in the marine forms this seems to be wanting, and its place is probably filled and its function discharged by the general contractility of the inner wall of the cell.

Joliet† has investigated the corpuscles which are found

* How, then, shall we account for the presence of a similar fluid in the internodes of the stem of the *Ctenostomata*, which (though homologous with the zoecium) are destitute of a polypide?

† 'Bryozoaires des côtes de France,' pp. 39-41.

floating in the nutrient fluid, and finds that large numbers of them are derived directly from the tissue which he has named *endosarc*—are indeed the cells of this tissue, somewhat modified in shape. He has seen the latter, on the endosarcial cord which traverses the stem of the *Ctenostomata*, exhibiting the precise form and structure of the floating corpuscles, and on the point of detaching themselves from the cord. In some cases they are round or slightly oval, and consist of a delicate membrane and transparent contents, in which one or more very minute and refringent granules are present. In other cases the membranous envelope incloses a compact mass of granules, which are often set free by the rupture of the sac and swarm in the perigastric fluid. These floating cells, emitted from the substance of the endosarc, Joliet compares to the blood-corpuscles of the lower animals.

THE ENDOSARC.

(=the “*colonial nervous system*” of Fritz Müller.)

We have not yet exhausted the contents of the perigastric cavity. Besides the muscular bands which pass from the cell-wall to the body of the polypide, we find a contractile cord connecting the base of the stomach with the lower part of the cell, which is known as the “*funiculus*” (Woodcut, fig. xix. *f*)*.

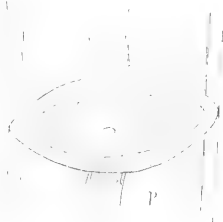
This structure is not only connected with the lower extremity of the digestive sac, but spreads for some distance over one side of it, and not unfrequently gives off

* The funiculus probably assists in the retraction of the polypide, drawing the stomach down towards the bottom of the cell; it also serves to keep this organ in its proper position when the polypide is expanded.

filamentary prolongations, which attach themselves at various points to the endocyst.

There is nothing constant either in the number or direction of these offsets; but they are sometimes largely developed, and look like so many stays or supports to the alimentary canal. The funicular cord (in such a form as *Bowerbankia*, Woodcut, fig. xiv.) attaches itself to the wall of the cell immediately over the perforated plate or septum, which closes it below, and at the point of attachment expands into a somewhat hemispherical granular mass. From this a thread-like prolongation passes off through the pore in the diaphragm, and forms a link of communication with the rest of the compound organism. In all the Ctenostomatous Polyzoa the stem or stolon, along which the zoecia are distributed, is traversed by a cord (Woodcut, fig. xv. *ec*), resembling in essential structure the funiculus; and with this the polypides are connected by means of the funicular threads just described*. But the stem (or stolon) is not a continuous tube; it is divided into numerous compartments, which are separated from one another by a septum or diaphragm, perforated in the centre like that of the cell (*s*, Woodcuts, figs. xv. & xviii.). On each side of these septa the cord usually dilates into a hemispherical mass (*endosarcial knot*); and the two hemispheres, divided only by the

Fig. xiv.

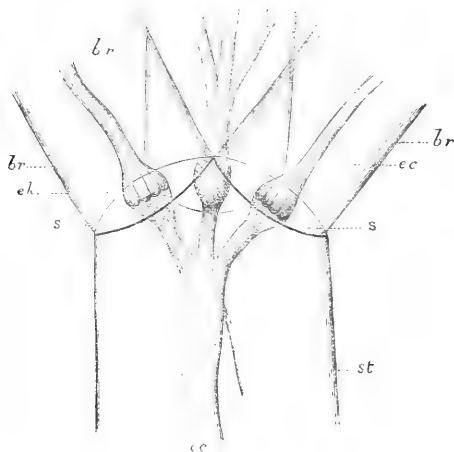


*Septum in stem of
Bowerbankia. p. Pore.*

* Ellis first noticed the funicular cord in the stems of *Vesicularia*. Farre speaks of it as a "direct medium of communication between the animals."

thin partition, present the appearance of a single sub-globular collection of granules (Woodcut, fig. xv. *ek*). The cord traversing one compartment is linked to that of

Fig. xv.

*Ctenostomatus stem.*

st. Stem. *br.* Branches. *s.* Septa, at the origin of the branches.
ec. Endosarcal cord. *ek.* Endosarcal knot.

the next by a thread-like extension of its substance, which passes through the pore or pores in the septum. Not unfrequently the cord gives off from its surface a number of filamentary processes, which sometimes anastomose, and sometimes pass directly to various points on the wall of the tube, the whole forming a rude network of fibres, or plexus. This portion of the structure is very irregular and variable, and, according to Joliet's observations, is liable to frequent change and modification*.

* "Dans l'espace de peu de jours une portion du plexus s'est modifiée sensiblement sous mes yeux, puisque j'ai vu un de ses rameaux s'atrophier et disparaître totalement." The foregoing account of the funicular system is based chiefly on the researches of Joliet ('Bryozoaires des côtes de France') which I can confirm in most points from my own personal observation.

The whole system of cords now described, with its globular enlargements at the junction of the zoëcia with the stem, and of one compartment of the stem with another, and its filamentary offshoots, exhibits the same essential structure, and must be regarded as composed of one and the same tissue. Its histological character has been studied by Nitsche, Reichert, and Joliet, but most

Fig. xvi.



Cells of the Endosarc.

exhaustively by the latter writer. It is composed in great measure of minutely granular fusiform cells, either with or without a distinct nucleus, attenuated and pointed at the two extremities, and somewhat swollen in the centre, which are disposed longitudinally in the tissue. (Woodcut, fig. xvi.). In some cases the cord is laden with refringent granules, which are so crowded as almost to conceal it.

The plan of the endosarc (to adopt Joliet's name for this tissue) varies somewhat in the different divisions of the class. Amongst the *Cheilostomata* (for instance),

where there is usually no stolon, and the cells rise immediately one from the other, the connective cord is of course not developed. But even amongst these there are exceptions; in *Bicellaria ciliata*, in which the true zoecium is borne on a kind of peduncular support, the latter is traversed by a cord, which communicates at the base of the cell with the funiculus.

In *Membranipora membranacea*, each cell of which is connected with several others, Nitsche describes two lateral strings or funiculi, extending down the sides of the zoecium, and in contact with each of the communication-plates, which occur at intervals in its walls*.

But whatever may be the diversities of plan, the endosarc is essentially one in histological character. It remains to determine its function and physiological import.

Fritz Müller was the first to attempt the interpretation of this element of structure †; and his views have been widely accepted by subsequent writers on the Polyzoa. He regards the funicular system as a true nervous structure, but one which is related to the life of the colony rather than to that of the individual zooids composing it. To him it is a common or colonial nervous system, which has to do with "the associated movements" of the Polyzoa, or such as do not seem "to depend upon the will of the individuals, but to be carried out by them in obedience, as it were, to a command from a higher quarter." Müller's attention seems to have been first drawn to the subject by the behaviour of the polypides in certain cases, which appeared to point to the existence of a

* Zeitsch. f. wissensch. Zool. xxi. Heft 4, p. 45.

† Archiv für Naturgeschichte, 1860, p. 310, pl. xiii.; translated in Quart. Journ. Micr. Sc. vol. i. (n. s.) p. 300.

system of nerves apart from the zoëcia, by which the members of the colony are to some extent controlled and brought into relation. He approached it on the physiological side, and perhaps, as Joliet has suggested, too much under the influence of an *a priori* conception. The colonial nervous system, as developed in each branch, consists, according to Müller (whose observations were made on a Ctenostomatous form), of *ganglia* placed at the origin of the branch, at the internodes, and at the base of the zoëcia, of a *nerve trunk* running the entire length of the branch, and of a *plexus of nerves* resting on the trunk and connecting the ganglia. He also describes a nerve passing from the zoëcial ganglion to the polypide. If we compare this scheme with the funicular system just described, we shall at once recognize the general correspondence between them. The ganglia are the granular enlargements, at the base of the zoëcia and at the internodes; the trunk is the connective cord; the plexus is represented by the filamentary processes given off from the latter; the nerve between the polypide and its ganglion is the funiculus. The simple question is, will these parts bear the construction which has been put upon them?

Müller's views were adopted by Smitt* (who traced the supposed nervous system in the *Cheilostomata*), by Claparède†, and others; indeed for some time they seemed to command very general assent. It is only as the result of minuter histological research, and a more careful study of the general history of the tissue in question, that a change of opinion has set in. I fully

* 'Om Hafs-bryozoernas Utveckling och Fettkroppar,' 1865, p. 31-33.

† "Beiträge z. Anat. und Entwicklungsgesch. von Seebryozoen," Zeitsch. f. wissensch. Zool. xxi.

participate in this change; and the account which follows will supply the grounds on which I have abandoned my former views on this subject.

It must, I think, be admitted that the interpretation first suggested by Fritz Müller was founded rather on mere superficial resemblances and the supposed fitness of things than on any thorough investigation of the structure and functions of the so-called nervous system.

Nitsche, after a careful examination of the tissue in question, decides against that interpretation*. Reichert has given us an elaborate account of it, and has pointed out the important fact, that the supposed ganglia are cut in two by the septa, which separate the internodes from each other and close the zoëcia below. He holds that the tissue is not nervous in character†.

But by far the most important contribution to our knowledge of this element of polyzoan structure has been made by Joliet. It is not in the slightest degree to detract from the merits of this most able observer to say that further investigation is required before some of his conclusions can be finally accepted. But so far as the general nature of the funicular system is concerned, his testimony seems to me to be conclusive.

I am unable to enter here into the detail of his exhaustive researches. I shall merely indicate briefly the characteristics of the tissue, which, in my judgment, are incompatible with Müller's theory.

i. Its intimate structure; the form and behaviour of the cells composing it are not those of a nerve-tissue.

The cells are normally fusiform (Woodcut, fig. xvi.);

* Ueb. *Flustra membranacea*, loc. cit. p. 56.

† Abhandl. Ak. Berl. 1870, physikalische Klasse.

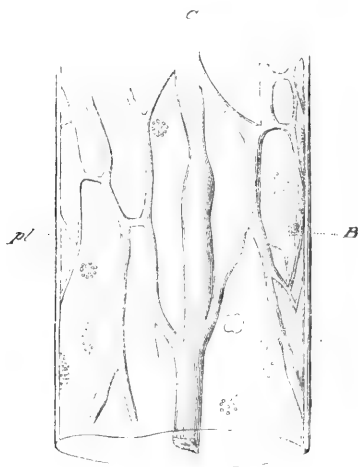


but both shape and contents vary even in different portions of the same branch.

ii. The changeableness and indefiniteness, so to speak, of the system itself, as exhibited in the cord, and more especially in the so-called plexus, are evidence to the same effect.

The cord or trunk presents the most varied appearances, being sometimes simply cylindrical (Woodcut, fig. xv. *ec*), sometimes composed of a number of anasto-

Fig. xvii.



Portion of Branch, showing Cord and Plexus.

B. Portion of branch. C. Cord. *pl*. Plexus.

mosing strands, sometimes resolved into a wide, irregular, open-meshed network*. It also varies in histological character, and is frequently charged with granular matter, which completely changes its aspect. But it is in the plexus (Woodcut, fig. xvii. *pl*), so essential an element of the supposed nerve-system, that the irregu-

* Reichert, *op. cit.* pl. iv. figs. 13 & 15, and pl. v. fig. 18.

larity and indefiniteness are most apparent and striking*. The so-called nerve-threads exhibit no constancy, either of number or direction; they do not seem to have any special aim. They reach the wall of the cell or stolon now here, now there, as if at haphazard. They are found directing themselves to the most unlikely spots, and conducting the (supposed) nervous influence to points where it would seem to be least wanted. Their behaviour certainly is much more that of stray sarcodic filaments than of the servants of a regularly organized and essential system. This indefiniteness in the structure of the plexus had attracted my attention before I had any misgivings as to the correctness of Müller's views; and it now seems to me to supply one of the strongest arguments against them.

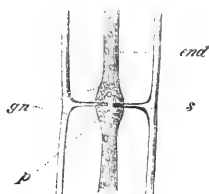
iii. In essential structure the funiculus agrees with the cord, with which it is directly connected at the base of the cell. It is contractile, as already mentioned, and in some measure plays the part of a muscle. Its contractility no doubt arises from the modification of some of the fusiform cells composing it, out of which, it would seem, in all cases the muscular tissues are formed. It is a kind of cable, attaching the polypide to its cell, and so organized as to admit of the free movement of the former as it issues from its dwelling and again seeks its shelter. Whether we regard its structure or its uses,

* The plexus described by Müller in the branch has its equivalent in the filamentary offshoots from the funiculus in the zoecium; and any student of the Polyzoa must have noticed their great irregularity and apparent aimlessness. Claparède has remarked, "On ne trouverait peut-être pas deux loges où le plexus soit semblable à lui-même." Smitt has also observed that the plexus varies greatly in the different cells of *Memb. membranacea*, and that the same is the case with the (so-called) nervous filaments in *Scrupocellaria scruposa* (*op. cit.* p. 32).

we can hardly, I think, identify it with any form of nerve*.

iv. The supposed ganglia are not constructed as F. Müller imagined them to be. He overlooked (in common with other observers) the septa, by which the branch is divided into compartments, and by which the ganglion itself is divided into two separate halves. As a matter of fact, the latter is made up of the enlargements of the cord, at the points where it touches the opposite faces of the septum, and appears to have no further significance. The pore or pores in the centre of the septum (as already

Fig. xviii.



Portion of a Branch.

end. Endosarcal cord. *s.* Septum. *p.* Pore. *gn.* Supposed ganglion.

explained) allow of the passage of certain threads, which maintain a connexion between the two sections of the cord; but the two granular masses never come into contact. With a true understanding of the structure, the ganglion disappears from the system.

Further evidence against Müller's view of the funicular tissue may be derived from the study of its general history and of the special functions which it is found to assume. For our knowledge of the latter we are indebted to Joliet; and I shall give a brief outline of his

* See Nitsche, "Ueb. *Flustra membranacea*," loc. cit. p. 56.

interesting researches, which have added a new and most important chapter to the history of the Polyzoa. So far, however, as the "colonial nervous system" is concerned, we hardly seem to require other evidence than that which has been already adduced. It is indeed, not impossible, as Nitsche allows, that certain of its elements might serve for the transmission of stimuli (a view which has been adopted by Reichert); but in the light of the later and more searching investigation we must, it seems to me, admit that as a system it wants the essential characters of nervous tissue.

ORIGIN AND FUNCTIONS OF THE ENDOSARC.—The tissue, commonly known as the "colonial nervous system," but to which I shall now assign Joliet's name, is, according to this author, a derivative from the endocyst. It is formed by differentiation of the cells in the growing extremities of this membrane; these become detached, send out prolongations posteriorly (which ultimately anastomose), and constitute the rudiments of the endosarc*. The latter maintains numerous relations with the endocyst, but is histologically distinct from it, being composed for the most part of fusiform cells, usually (but not universally) destitute of a clearly defined nucleus.

The endosarcal system comprises the funiculus, the connective cord, and the network so often associated with them, both in the zoëcia and in the compartments of the stem, and also (according to Joliet) the parenchyma in the stem and stolon of *Pedicellina*, and the muscular layer connected with the endocyst amongst the

* Joliet states that he has observed this process in many species. It would be satisfactory to have a somewhat fuller account of it than he has given us.

freshwater Polyzoa. Some of these determinations may be open to criticism, and certainly require the confirmation of further research; but on the whole the French zoologist seems to me to have made good the leading points of his case, and to have worked out with much ingenuity and skill the morphology of this tissue.

We pass now to the functions of the endosarc. If not a nervous system, what part does it play in the economy of the polyzoon?

According to the observations of the writer just quoted, it equals in importance the principal constituent tissues, and deserves to be ranked as one of them. Its relation to the floating corpuscles in the perigastric fluid has already been noticed. It is also the source of the male reproductive elements, and in a large proportion of cases, if not universally, of the ova*. It has long been known that the spermary is developed on the funiculus†. Mother cells, each containing one or more minute nucleated vesicles, are differentiated from the substance of the cord, and cluster thickly round it, forming an irregular mass‡. They finally detach themselves, singly or in clusters; and from each of the contained vesicles a spermatozoon is liberated. The spermary is present on the funiculus at a very early stage in the development of the polypide (as I have observed in *Farrella repens*), and usually occupies

* In this section I shall report in brief the conclusions at which Joliet has arrived, with such critical and illustrative remarks as they may suggest.

† Allman, indeed, describes the testicle in the freshwater *Paludicella* as attached to the inner surface of the endocyst; but it is placed at the point where the funiculus reaches the cell-wall, and no doubt has its origin in it.

‡ Smitt has described the production of spermatozoa from the floating corpuscles in the perigastric fluid *in the absence of any definite spermary*, these corpuscles being, as we have seen, derived from the endosarc ('Om Hafs-bryozoernas Utveckling och Fettkroppar,' pp. 37, 38).

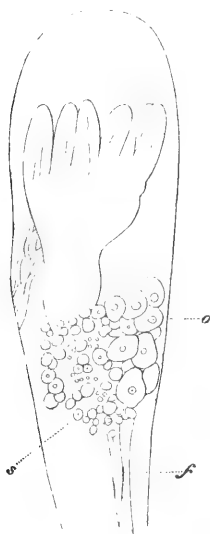
the lower portion of it. But Joliet also contends that the ova are generally, if not always, a product of the endosarc; and in taking this position he runs counter to the common opinion. Huxley, indeed, has described both ova and spermatozoa as developed from the funiculus in *Bugula avicularia*; but the received view undoubtedly has been that the former are developed normally from the endocyst, at various points of the cell-wall, but usually towards the upper extremity of the zoëcium. They are so figured by various authors; and in this position I have myself observed them. On the other hand, Joliet has seen the ova produced in the funiculus (*i. e.* in the endosarcal tissue) in a considerable number of species, and has minutely described their position and the course of their development*. He also holds that in many at least of the cases reported by authors, the ova which they describe as derived from the endocyst, are really the product of the endosarc. For example, in *Farrella repens* the ovary was long since distinctly figured by Van Beneden† on the upper part of the cell-wall, and described as a growth out of its inner layer. I have seen it in this position, presenting all the appearance of a pouch fastened to the lining membrane of the cell. On examining young zoëcia of this species, in which the bud was in course of development, Joliet has found the mother cells even at this early stage surrounding the funiculus. As the growth of the polypide advanced, the cells on the *upper* portion of the funiculus had multiplied to a great extent, and taken on a special

* He has positively determined the production of ova in the funiculus of seven species.

† "Recherches sur l'organisation des *Laguncula*," Mém. Acad. Roy. Brux. vol. xviii. pl. i. fig. 1, A, B.

form—that of rudimentary ova; they constituted a considerable mass, which extended to the wall of the zoëcium, and became adherent to it (Woodcut, fig. xix.); the rest

Fig. xix.



Young Zoëcium of Farrella.

f. Funiculus. *o.* Mass of ova, extending to the cell-wall. *s.* Sperm-cells.

of the funiculus was covered by the sperm-sacs. As these gradually detached themselves, and the substance of the testicle had become reduced in size, the adherent mass of ova was found to be separated from it, and was left on the face of the cell-wall. In this position only it has been seen by those who describe it as developed on the endocyst; but it is really, like the testicle, derived in the first instance from the endosarc. Upon this I would merely remark that the explanation seems hardly to meet the facts of the case, inasmuch as an adherent mass of

ova cannot be regarded as the equivalent of the *distinct ovary* which Van Beneden figures, and which I have myself seen.

Nitsche has seen ova produced on the cell-wall in *Bicellaria ciliata*, and Smitt in *Scrupocellaria scruposa*. These cases Joliet is unable thus far to harmonize with what he regards as the general rule ; but he suspects that here also the parietal ova may be in connexion with some offshoot of the endosarc, perhaps with the threads which pass through the communication-plates from cell to cell. Clearly this branch of the subject requires a much fuller investigation.

As variations upon what seems to be the more usual plan, Joliet has noted that in a *Lepralia* (*L. Martyi*) the ovary is placed *at the very base* of the funiculus, immediately above the communication-plate ; whilst in a *Membranipora* (*membranacea*) it occurs *on the upper part of the cell-wall*, also in immediate connexion with the same structure*.

On the whole, it may be regarded as established that the *testicle* is all but universally derived from the funiculus, invariably from some portion of the endosarc—that the *ova* are in a considerable number of species also developed in the funiculus—that in one case at least they originate from the endosarc apart from this organ, but in connexion with a communication-plate—and that in several cases they are placed on the cell-wall, but

* As in some measure confirmatory of this writer's view, I may draw attention to Allman's figure of the freshwater *Paludicella* (Freshwater Pol. pl. x. figs. 3, 4), in which the ovary is represented on the cell-wall, but in direct communication with the "superior funiculus," a cord which proceeds from the upper portion of the alimentary canal, while the testicle bears the same relation to the ordinary funiculus below.

whether a product of the endocyst or endosarc is still undetermined.

That the latter tissue is, to a large extent at least, concerned in the production of the generative elements can hardly be doubted; and this fact is properly accounted evidence of its non-nervous nature.

According to Joliet the polypide is also produced by gemmation from the endosarc, at least in many cases (he is inclined to think, universally), and not from the endocyst, as generally supposed. We must have a much wider range of observation bearing on this point than we at present possess before we can come to any general conclusion about it. But in the case of *Eucratea chelata* there seems to be no doubt that the polypide originates from the funiculus: we have the concurrent testimony of Joliet* and Barrois† on this point. Further, in all the *Cheilostomata* which he has studied, the former of these observers has seen reason to believe that the bud is really formed on some portion of the endosarc, and not on the endocyst. In *Hypophorella*, Ehlers (allied to the *Vesiculariidae*), it is produced on the funiculus, in the centre of the cell, as in *Eucratea*. In many cases it is developed at the very base of the zoëcium, immediately over the communication-plate or septum and the orifices through which the connective threads pass, and therefore probably in connexion with the endosarc. I have observed it in this position in the young cell of *Beania mirabilis* (Woodcut, fig. xx. *bd*); and in this species Joliet has convinced himself that the polypide is actually derived from the endosarcial cord. In the rudimentary zoëcium of *Victorella* (see page 560) the

* *Op. cit.* p. 50, pl. xiii. figs. 1, 2.

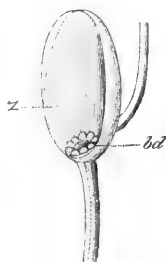
† 'Revue Scientifique' for Sept. 29, 1877.

forming polypide seems to me to be enveloped in the endosarcial plexus, and to be (in all probability) produced by it. In *Pedicellina* the origin of the polypide is doubtful*. So the matter rests for the present. In a large number of cases undoubtedly the polypide owes its origin not to the endocyst proper, but to the tissue composed of fusiform elements, which has its most familiar representative in the funiculus. It may be, as Joliet suggests, that the authors who have referred it to the endocyst have not been sufficiently alive to the distinction between these two tissues; it may be that the function is to some extent shared by the endocyst. Further investigation, along the lines now indicated, must decide the point.

The question arises, whether this tissue, constituted as we have seen, and endowed with such physiological attributes, is to be regarded as a mere dependence of the endocyst, or whether it is more properly characterized as one of the principal elements of the Polyzoan structure.

Looking to the peculiarity of its histological character, to the undoubted importance of the part which it plays in the animal economy, and to its distinctness and definiteness, *as a whole*, Joliet is amply justified, in my judgment, in distinguishing it by a separate name, and assigning it a special rank. He is also wise, at the present stage of inquiry, in selecting a name for it which has no theoretic flavour, but simply indicates a fact.

Fig. xx.



Young Zoecium
of Beania.—z. Zoecium.
bd. Polypide-bud.

* Salensky, "Entoproctes," Ann. Sc. Nat. sér. 6, vol. v.

THE FALL AND RENEWAL OF THE POLYPIDE.

The "Brown Body."

Every student of the Polyzoa must have noticed that the life of the individual polypides is comparatively ephemeral. In most cases a large proportion of the zoœcia have lost their original tenants, while at the same time the zoarium retains its vitality, and along the margin fresh additions are continually being made to it by the growth of new buds. Not uncommonly almost all the cells covering the lower or older portions of a tuft of *Bugula* or *Bicellaria*, for example, are thus emptied of their polypides; but towards the upper extremities of the branches all are occupied by an active population, and along the outer edge zoœcia are to be seen in every stage of development. The disappearance of the polypide, however, is a comparatively unimportant incident in the life of the colony; and ample provision exists for securing new tenants for the deserted dwellings. The zoœcium which has lost its polypide is in turn filled by another, and may possibly be the home of a succession of occupants.

If we examine a specimen of one of the erect plant-like Polyzoa, we shall find, as I have stated, along the upper edge of the branches, zoœcia in course of formation, and exhibiting every degree of development; immediately below these will be zoœcia in which polypides are formed, but immature; below these again will extend a zone inhabited by adult polypides in full vigour and activity; further down still we shall probably encounter dwellings for the most part destitute of tenants. Of course these

divisions are not invariable, nor are they separated by any hard lines; but such is the general condition of the colony. In most of the tenantless zoëcia a dark, more or less spherical body occurs, which exhibits a definite and uniform appearance. It consists of a mass of brownish granular substance enclosed in a membranous cyst, the inner walls of which are covered with reddish-brown spots. It is generally placed about the middle of the zoëcium, occupying, in fact, the same position as the lower portion of the digestive sac of the polypide, and, like it, is firmly attached to the funiculus and to the network of filaments which proceeds from it*. This is the well-known "brown body" of authors (Woodcut, fig. xxi.). Two or even more may occasionally occur in the same cell.

These bodies, which frequently give a dotted appearance to the zoarium, are much too conspicuous to escape the notice of observers; and accordingly we find them referred to by most writers on the Polyzoa from Ellis downwards†. We are now in the region of controversy. Around the "brown body" have gathered conflicting observations and rival theories. Its origin and its end have been alike in dispute. Many of the opinions that have been held about it no longer claim our consideration; they have already been finally disposed of. I shall here confine myself chiefly to two opposite views of the nature of

* See a paper by the author, entitled "Contributions to the History of the Polyzoa," *Quart. Journ. Micr. Sc.* xiii. (n. s.), p. 24.

† For a historical account of the various opinions entertained about them see:—Smitt, "*Bidrag till Kännedomen om Hafs Bryozoernas Utveckling*," *Ups. Univ. Årsskrift*, 1863; the paper by the author, just cited, pp. 17–23; and Joliet, *op. cit.* pp. 7–9. They have been regarded as the remains of the dead polypides, as ova, as ovaria, as statoblasts, as a secretion from the endocyst, as a store of nutriment for the young polypide, as a reproductive body formed out of the stomach of the decaying polypide. We may well say, with Joliet, "*Ces corps bruns ont bien intrigué les observateurs*"!

this body—that which regards it as the mere lifeless *débris* of the defunct polypide, and that which recognizes in it a special structure, derived indeed, from the substance of the histolyzed polypide, but endowed with a reproductive function, and capable of originating a successor to it in the occupancy of the cell.

The latter opinion has been maintained by the able Scandinavian zoologist, Prof. F. A. Smitt, whose researches have added so largely to our knowledge of the Polyzoa; and he has supported it by a considerable body of careful observation. My own studies had led me to adopt his view; and on various occasions I have recorded the grounds on which my conclusions were based. The opposite opinion has had able exponents in Nitsche and Joliet. They find in the “brown body” nothing but the remains of the decayed polypide, a mass of inert material waiting to be ejected from the cell. Another interpretation has been adopted by Repiachoff*. To him the “brown body” is not concerned directly in the production of a new polypide, but at a certain stage it is enveloped by the forming bud in its substance, and serves as pabulum for it during its further development.

It is quite impossible for me to reproduce in detail the observations which have been adduced in support of the conflicting views. I must refer the student to the works in which they are recorded. The theory of Smitt has been subjected to an elaborate examination by Joliet, in the course of which he has criticised at length and with much acumen my own contributions to the discussion. My object will be to point out how far and in what way the

* “Zur Naturgeschichte der chilostomen Bryozoen,” *Zeitsch. f. wissensch. Zool.* vol. xxvi. (1876).

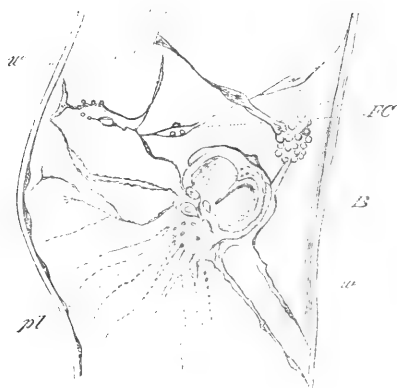
evidence relied upon by Prof. Smitt and myself is affected by this criticism and by later observations, and what the present state of the question seems to be. This course will clearly be the most valuable to the student, as it will indicate to him the directions in which further research may be profitably conducted. And as, of course, the only object to be aimed at in such work is the discovery of *the actual fact*, I shall endeavour to approach the subject without any controversial *animus*.

i. As to the origin of the "brown body," if we except Claparède, who regarded it as a secretion from the endocyst*, observers are generally agreed that it is derived from the substance of the polypide. As the latter, after a longer or shorter term of existence, gradually fades away, it gives origin to a "brown body," which remains attached to the funicular cord, and more or less enveloped by the plexus of threads arising from the latter. Joliet would call it the mere wreck of the polypide; Smitt has named it the "germ-capsule" (*groddkapsel*) implying that it has in it the possibilities of new life. In my papers on the subject, I have held that the "brown body" is formed out of the lower portion of the digestive sac, which in some species (e. g. *Bicellaria ciliata*) has the appearance of being separated by a constriction from the rest of the stomach, and constitutes, as it were, a separate chamber of somewhat globular shape (Woodcut, fig. x.). This peculiarity of structure I have connected with the formation of the germ-capsule; but I am now satisfied that this

* "Beiträge zur Anatomie u. Entwicklungsgeschichte der Seebryozoen," Zeitsch. f. wissensch. Zool. December 1870, p. 147. Claparède's view must be considered a simple corollary from his extraordinary theory of the "retrogressive metamorphosis" of the polypide, rather than the result of any close and careful observation.

is an error. This cæcal appendage (see page xxv) is a permanent feature of the alimentary canal in the species

Fig. xxi.



Cell of Hypophorella, with "Brown Body."

B. Brown body. *pl.* Plexus. *FC.* Fusiform cells. *w.* Wall of zoecium.

in which it occurs, and has no special relation to the development of the "brown body." I now agree with Joliet in regarding it as due to a thickening of the outer wall of the stomach, and not, as I once supposed, to a real constriction of the part, indicating a gradual separation of the lowest portion of the cæcum from the rest of the digestive canal. The question remains, whether the "brown body" is formed out of the whole of the polypide or merely out of the digestive sac. Joliet regards it as the *débris* of the whole structure; and his observations and figures seem very conclusive so far as the species which he examined are concerned. Smitt, if I understand him rightly, holds that it originates from the stomach of the polypide; and such was certainly my own impression.

Ehlers records an observation which would seem to show that, in *Alcyonidium* at least, the tentacles are separated from the alimentary canal during the progress of the histolysis*.

In any case the "*brown body*" is derived from the polypide, and is the result of its decline.

ii. As to its nature and destination, is it capable of giving origin to a new polypide? The simple ground on which Prof. Smitt and myself have taken the affirmative side is direct observation. In numerous cases the Swedish zoologist has traced the formation of a bud on the "*brown body*," and, as it seemed to him, out of its very substance†. My own observations have been to the same effect. Repeatedly I have seen gemmation taking place in the closest proximity to the surface of the "*brown body*;" and the bud, as I was fully persuaded at the time, was continuous with it and a growth out of it. One thing, at least, we may claim to have established and brought prominently into view, the fact that there is so commonly the closest association between the polypide-bud and the "*brown body*" in the cell of the Polyzoon.

Fig. xxii.



Another point my observations seemed to me to have established—that the polypides developed from the (so-called) germ-capsule differ in appearance during their early stages from those which are found in the young marginal cells of the colony, and from other buds which occur in the adult zoëcia. The latter are destitute

* "*Hypophorella expansa*, ein Beitrag," &c., Abhandl. königl. Gesellsch. d. Wissensch. zu Göttingen, vol. xxi. (1876)p. 122.

† *Op. cit.* pp. 23-29, pl. v. figs. 5, 17-19. See Woodcut, fig. xxii.

of the reddish-brown colour imparted to the stomach-wall at a later period by the biliary glands, whilst the

Fig. xxiii.



Fig. xxiv.

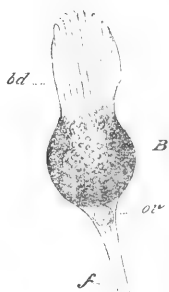
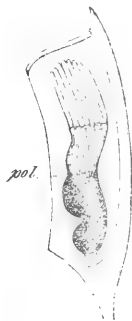


Fig. xxv.



B. Brown body. *bd.* Bud. *ov.* Ovary. *f.* Funiculus. *pol.* Polypide supposed to be developed from the brown body*.

former, being (according to my view) a growth out of the brown body, possess it from the first.

Unfortunately I have been unable to repeat my observations to any extent with the help of the new lights which later researches have cast on the subject; much less have I had the opportunity of doing so under the favourable conditions supplied by the modern Zoological Station†. I shall confine myself now to stating very briefly how these observations are affected, in my judgment, by

* These three figures represent the supposed budding of the polypide from the brown body, and are copied from my paper on the "germ-capsule," *loc. cit.*

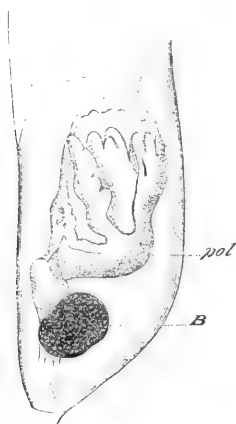
† Prof. Smitt has not made any addition to his early observations on this point; but in a letter recently received from him he says (after explaining that he had not entered into the latest researches), "Still I retain my standing-point, because it seems to me impossible to interpret the observations in another way. I have followed the formation of the germ-capsules out of the histolyzed digestive canal. I have prepared them out of their connexion with the funicular plexus; and after thus making loose the germ-capsules, I have seen the bud of the new digestive canal either inclosed in them or protruding out of them."

facts which have been brought to light since they were made.

Two points bear directly upon them :—i. Repiachoff's very curious observation, that the "brown body" is actually taken into the substance of the young bud, supplemented by Joliet's, that it afterwards passes entire into the intestine and is ejected through the anus, or is dissolved in the stomach and the remains disposed of in the same way*; and ii. Joliet's interpretation of the funicular tissue (which, it must be remembered, more or less involves the "*brown body*"), and its relation to the development of the polypide (see page 1).

To take the latter first. Joliet holds that the buds

Fig. xxvi.



Polypide developed on the surface of a Brown Body.

B. Brown body. *pol.* Polypide.

which Smitt and myself supposed to be formed out of the "brown body" are really developed out of the funicular plexus which overlies it, and which escaped our notice.

* (*Op. cit.* pp. 21-24.

A delicate layer of protoplasm derived from this plexus surrounds the "brown body"*; and, indeed (according to Joliet), the envelope which immediately incloses its granular contents is formed at the expense of this layer. It is from this protoplasmic covering, and not from the substance of the "brown body" itself, that the bud really originates; the case therefore enters into the usual order of development. In support of this view, Joliet asserts that the bud is always separated from the "brown body" itself by the membranous envelope, and is not in connexion with its substance (Woodcut, fig. xxvi.); but he adds, "*Il n'est certainement pas toujours facile de décider si c'est aux dépens du corps brun lui-même ou aux dépens de cette couche protoplasmique que se forme cette 'saillie de matière granuleuse' qui est l'origine du bourgeon.*" It certainly must be very difficult to decide the point; and in the absence of any suspicion that a tissue adequate to the formation of the polypide was present in the neighbourhood, an observer would almost inevitably refer the bud to the so-called germ-capsule as its source. Joliet's researches, showing that the endosarc, by which the brown body is more or less surrounded, is *such a tissue*, materially alter the case, and prove that the appearances upon which I relied may possibly be susceptible of a different explanation. At the same time, I must add that the bud in the cases referred to always seemed to me, after careful examination, to be directly continuous with the "brown body," an uninterrupted growth out of it, as represented in my figures.

Secondly, what is the relation of Repiachoff's observa-

* Ehlers had previously described the "brown body" in *Hypophorella* as enveloped by a protoplasmic substance, *op. cit.* p. 119.

tion to the theory of the germ-capsule? At a certain stage the bud, whether developed at a greater or less distance from the "brown body," approaches it, extends its substance over it, and finally lodges it in its stomach, the walls of which completely close around it (Woodcut, fig. xxvii.). Thus engulfed it serves (he conjectures) as a store of nutriment for the growing structure.

Fig. xxvii.



pol. Polypide (budding). *st.* Stomach. *B.* Brown body, inclosed in the latter.

Joliet, on the other hand, has witnessed in one species the same process of ingestion; but the "brown body" was subsequently driven through the intestine and expelled unaltered through the anus. In another species it was enveloped by the bud, and dissolved in its stomach; the coloured granules composing it were retained for a short time only, and then rejected*. These observations are precise, and leave no doubt as to the facts. In the cases to which they refer, the relation between the "brown body" and the bud is, of course, totally different from that which is assumed in the theory of Smitt. The young polypide, instead of originating from the former, becomes the channel through which it is removed, as a useless encumbrance, from the cell. Again, in other cases the "brown body" has a different destiny: in these it seems to be (sometimes at least) separated from the funiculus and cast to one side of the cell, as so much lumber. These facts, unsuspected when my observations were made, seem to me, I confess, to have a most important bearing on the point at issue, and to call for a careful reconsideration of the whole question.

* In such a case it is by no means improbable that the "brown body" pays toll of nutritious matter to the polypide as it passes outward.

Joliet imagines that the deeply coloured buds, which I supposed to originate from the germ-capsule, were really buds tinted by the granules of a "brown body" which had been thus dissolved in their interior. But this explanation seems to me inadequate, as the appearance referred to was presented by buds which had reached a stage of development in which all traces of the substance of the brown body must have vanished from the stomach.

I will add a few further considerations that have been urged or may be urged against the theory of Smitt. i. If a branch of the polyzoon is treated with potash, all its soft portions (the polypides, the endocyst, the endosarc) are destroyed, but the "brown bodies" survive and are commonly intact (Joliet). ii. The remains of the food (Diatomaceæ, Foraminifera, &c.) and the hard portions of the gizzard (in the species possessed of this organ) are sometimes recognizable in the "brown body" (Nitsche). iii. A very large number of brown bodies are often present in the colony, which undergo little or no change, and perish with the cell itself. These are usually found in the older regions of the zoarium, which are destitute of polypides; they show no signs of reproductive power. iv. Admittedly a very large number of the buds, by means of which the polypide is renewed, *are formed at a greater or less distance from the "brown body."** These buds have generally been regarded as the product of the endo-

* I may here record an observation made on a specimen of *Bugula calathus* which I had dredged in full life and vigour. After keeping it for two or three days the polypides over the lower two thirds (about) of a branch had perished, and towards the base of each cell was a roundish dark reddish-brown body. A little in advance of it in almost every zoecium was a polypide-bud, arising (as it then seemed to me) from the endocyst-floor of the cell, consisting of the crown of tentacles and a small sac suspended from it. Sometimes the "brown body" was almost close to the bud, sometimes a little way from it; but in all cases a separation between the two was here evident enough.

cyst; but, according to Joliet's views, they originate in the endosarc—that is, in the very tissue which supports and invests the brown body.

The following points may be taken as established :—

i. The brown body is universally derived from the substance of the histolyzed polypide. ii. It is always attached (when occupying its original position) to the funiculus, and more or less invested by the funicular plexus. iii. Buds for the production of a new polypide are very commonly developed in the closest proximity to it and on its surface. iv. They also originate in various positions, and at greater or less distances from the brown body. v. In some species the latter is enveloped by the neighbouring bud, and passes into the digestive canal, being ultimately expelled through the intestine, either entire or after having undergone dissolution in the stomach*. vi. There may be several brown bodies in a cell; and in some cases they lie loose in the perivisceral cavity near the bottom of it (Farre).

On the whole, and especially taking into consideration the later observations to which I have more particularly referred, I must admit that the evidence at present tallies better with the residuary theory of Nitsche and Joliet than with the reproductive theory of Smitt. At the same time I must also hold that no satisfactory explanation has yet been offered by our critics of the very precise observations of Smitt and of my own. There seem, therefore, to be grounds (*pro tanto*) for desiring some further investigation of the subject.

* I must allow that it is improbable *à priori* that the same body would be in some cases an important reproductive factor in the colony, and in others would be ejected as mere rubbish by means of a special arrangement.

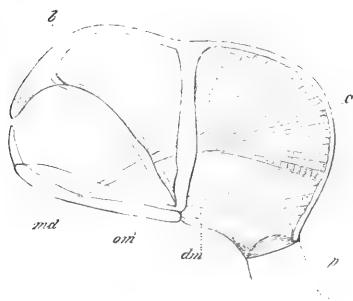
MODIFICATIONS OF THE ZOËCIAL TYPE.

The Avicularium and Vibraculum.

The structural type of which the zoëcium is the most familiar representative, exhibits a number of modifications amongst the marine Polyzoa; of these the most remarkable are the *avicularium* and the *vibraculum*. These curious appendages are confined to a single sub-order, the *Cheilostomata*, within the limits of which they occur in great abundance and variety. The *vibraculum* (probably a derivative from the *avicularium*) is rarely met with as compared with the latter, which is present in a large proportion of the Cheilostomatous genera*.

The avicularium is best known in its most highly specialized form as it occurs in the genera *Bugula* and

Fig. xxviii.



b. Beak. *md.* Mandible. *C.* Chamber. *p.* Peduncle. *om.* Oclusor muscles. *dm.* Divaricator muscles.

* Out of forty-five British genera of *Cheilostomata*, avicularia occur in thirty-one, vibracula only in four. In two genera *both* the appendages are present together.

Bicellaria. This is the true "bird's head," an articulated appendage attached to the zoëcium, with a formidable hooked beak and a mandible worked by powerful muscles, perpetually snapping its jaws with monotonous energy, and swaying to and fro with vigorous swing on its jointed base—grotesque both in form and movement.

But in a large proportion of cases the appendage exhibits a much simpler structure, and is totally destitute of the peculiar shape which has suggested its name. It is necessary to study its morphology *in extenso* to obtain a clue to its history; the articulated "bird's head" bears no trace of resemblance to the associated structures, which are yet undoubtedly of its kin; it has assumed an alien form, and has parted with all the familiar features of its tribe; its aspect and its habits are those of a foreigner; and as we watch it, even with its genealogy in our hands, we cease to wonder that it remained so long a mystery and a puzzle to the zoologist. When we come to consider the avicularium, not merely in its more complex and highly organized condition, but in its totality, as it is represented in a long series of gradational forms, we are left in no doubt as to its structural affinities. We can trace the course of its development from the first rudimentary stages, which are hardly distinguishable from the ordinary zoëcium, through a multitude of phases, up to the highly elaborated prehensile appendage in which no family likeness survives. And probably the best way of presenting its history will be to begin with the lowest forms in which it occurs, and to follow it through its chief modifications up to the highest.

It will be desirable, however, first to indicate the essential elements of its structure; and in doing so, it will be

necessary to avoid the descriptive terms which might naturally be suggested by the organization and apparent function of the true "bird's head." The latter would seem to be a grasping organ; but in a large proportion of the lower forms there is nothing that can properly be called a "beak," whilst the equivalent of the mandible is utterly inefficient for prehensile purposes.

Every avicularium consists of a chamber, of variable size and shape, in which is lodged an apparatus of muscles, of a movable horny appendage which is worked backwards and forwards by the muscles, and of a fixed frame opposed to it surrounding an aperture, upon which it falls when closed. In many cases, if not in all, the chamber also contains a cellular body, which is in all probability the homologue of a polypide.

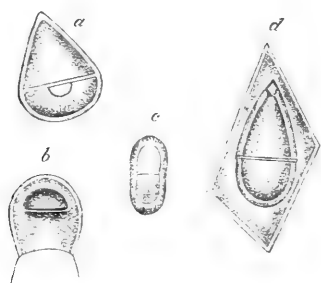
These elements may compose a structure very closely resembling the ordinary zoëcium; or they may be so modified as to constitute an articulated and prehensile appendage, armed with curved beak and powerful jaws, and provided with a delicate tactile organ such as we find in the genus *Bugula*. In all cases the avicularium is to be regarded morphologically as a metamorphosed zoëcium*, though in its more complex forms there is little to betray its lineage.

Amongst our British Polyzoa we find this zooidal form

* In the zoëcium of the Cheilostomata the following parts may be distinguished, which should be borne in mind in studying the history of the avicularium:—(i.) the chamber, in which the polypide is lodged (Woodcut, fig. xxx. c); (ii.) a movable corneous plate (the *operculum*) which closes the entrance to it (fig. xxx. o); (iii.) two sets of muscles, by which this valve is opened and shut; (iv.) the aperture, an opening covered by membrane, which in many species occupies a considerable portion of the front surface of the cell (fig. xxx. a). In other cases this is wanting, and is replaced by a solid calcareous wall. The mandible of the avicularium, under all its modifications, is the homologue of the operculum.

in its most rudimentary condition in such genera as *Flustra* and *Cellaria*. Here it is not a specialized structure attached to the zoœcia ; it occupies the place of one of them in the colony. It consists of a dwarfed cell, on the upper surface of which is placed the usual oral valve, but which is destitute of a polypide ; at the same time the valve is frequently of unusual and disproportionate size, and occupies a large part of the area of the cell. Except in size, however, it has undergone but little change, though a certain variability of form already indicates its plasticity. In one species (*Cellaria sinuosa*) it assumes a triangular

Fig. xxix.



Primary Avicularia.

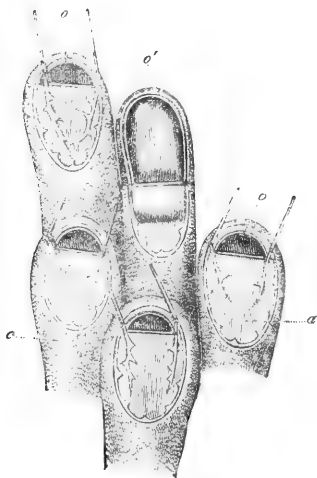
- a. *Cellaria sinuosa*. b. *C. fistulosa*. c. *Membranipora cornigera*.
d. *M. arctica*.

shape ; in the common *C. fistulosa* it is almost undistinguishable from the ordinary operculum. The degree in which the avicularian chamber (or cell) is reduced in size varies greatly amongst these primitive and rudimentary forms. In *Cellaria Johnsoni* it is a miniature copy of the normal zoœcium (see Plate XIII. figs. 11, 12), almost its only peculiarity being the elevation and somewhat increased size of the operculum. In other cases the atrophy of the cell is carried to a great extent, and the operculum occupies almost the whole of the area.

As specialization proceeds, the chamber is minimized, and the adaptive modification of the valve becomes more and more varied and elaborate. In the mandible of the "bird's-head" appendages it reaches its climax, whilst in this form the zoëcium itself has lost every trace of its original character and function, and merely lodges the machinery by which the curious prehensile instrument is worked.

Nowhere, perhaps, is the relation of the avicularium to the normal zoëcium more clearly traceable than in a

Fig. xxx.



Membranipora longicornis, n. sp.

c. Chamber, in which the polypide is lodged. *a.* Aperture. *o.* Operculum or oral valve. *o'.* Modified operculum.

foreign species of *Membranipora* (as yet, I believe, undescribed *), in which a very striking modification of the

* I propose to name it *M. longicornis*, from the remarkable serrated spines with which it is furnished.

operculum is combined with the slightest change in the character of the cell itself (Woodcut, fig. xxx.). In this species a number of zoëcia are scattered over the colony, which, whilst retaining in great measure the usual form, are distinguished by a remarkable elongation of the oral valve. This structure, which is normally semicircular in shape, is here much produced and somewhat elevated above, and stands out conspicuously on the surface of the zoarium. It is fully four times the size of the ordinary operculum, and of course increases very considerably the length of the whole zoëcium, which in other respects departs very slightly from the normal condition. The aperture is somewhat reduced, and the spines are aborted; but in general appearance these abnormal cells very closely resemble the other members of the colony. The polypide in such cases is probably suppressed. We have here, it would seem, one of the earliest and simplest departures from the normal type of the zoëcium in the direction of the avicularium. In *Flustra* the change is much more marked, as the cell is merely rudimentary, and the movable operculum constitutes the essential feature.

These slightly specialized forms, which fill the place of a zoëcium in the colony, may be distinguished as the *primary avicularia*. They occur under various modifications: in *Schizotheca fissa* the avicularium has an area of the same size and form as that of the zoëcia, the beak and mandible occupying much the same position as the oral opening (see Plate XLI. fig. 3). Nowhere is its morphological significance more apparent. A striking case of the same kind is presented by *Cellaria tenuirostris*, Smitt (Woodcut, fig. xxxii.). In *Schizoporella venusta*, on the other hand, the area (which replaces a cell) is reduced

to a very diminutive size, and has a minute rounded mandible (Plate XXX. figs. 6 *a*, 7) *.

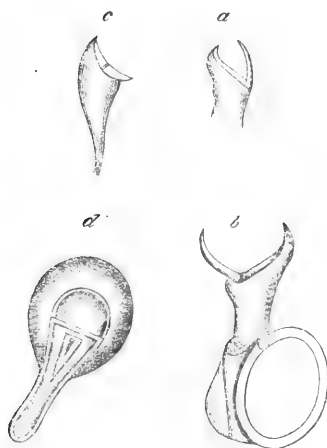
The next marked stage in the developmental series is characterized by the contraction of the area combined with the assumption of a more or less peduncular character by the hollow portion of the structure. The external resemblance to the ordinary zoëcia has disappeared; the cell is commonly represented by a subconical elevation, on the summit of which are placed the beak and mandible. At the same time the avicularium is now, for the most part, a secondary growth, and is developed, not on the original plane of the colony, but on the zoëcia themselves. There has been a large reduction in the size of the chamber, no longer required for the accommodation of the polypide, and a growing specialization of the mandible and its adjuncts. To a great extent the avicularium has lost its apparent *status* as a distinct zooid in the colony, and become an appendage of the zoëcium. The bosses or mounds, so often forming part of it and supporting the mandibular apparatus, are to be regarded as the homologue of the chamber in the normal zoëcium. Such forms as I have now described, and others allied to them, may be classed as *secondary* or *transitional avicularia*. We must not suppose, however, that they constitute a clearly defined section; they are connected at all points by intermediate forms with the primary group. Nor are these divisions coincident with any particular genera or families; the various modifications of the avicularium are distributed sporadically over the whole Sub-

* In this species the avicularia alternate with the ordinary cells throughout the colony. In the specimen represented in Plate XXX. fig. 7 there is a group of variously modified cells which strikingly illustrates the relationship between the primary avicularium and the zoëcium.

order, with the exception of the highest, which occur only within very narrow and definite limits.

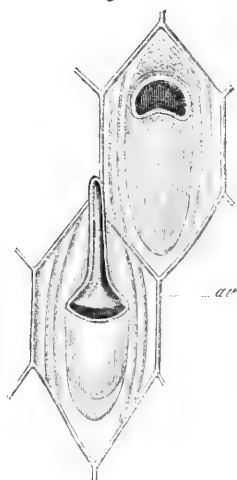
The raised or pedunculate character commonly assumed by the hollow portion of the avicularium in this division

Fig. xxxi.



a, b, c. Fixed pedunculate avicularia.
d. Mamillated avicularium.

Fig. xxxii.

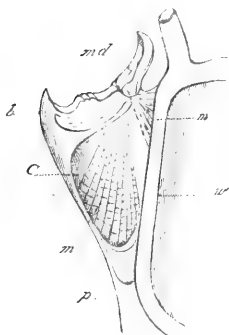


Cellaria tenuirostris.
av. Avicularian cell.

becomes very pronounced in certain cases. The beak and mandible are elevated on a distinct stem, and (we may suppose) obtain in this way peculiar advantages for the discharge of their function, whatever it may be. In such forms (Woodcut, fig. xxxi., *a, b*) we recognize an advance towards the peduncle of the true "bird's head." A nearer approach to it is met with in the remarkable pedunculate avicularia which occur in one or two species of *Membranipora** (Woodcut, fig. xxxi., *c*). The want of

* *Membranipora spinifera*, Johnston (see Plate XIX. fig. 1, *a, b, c*) and *M. cyathiformis*, Hincks.

Fig. xxxiii.

*Avicularium of Scrupocellaria scruposa.*

w. Wall of zoecium. c. Chamber of avicularium. m. Muscles.
p. Peduncular portion. b. Beak. md. Mandible.

mobility is perhaps the most essential distinction between this form and the avicularium of *Bugula*; the beak and mandible are less highly organized than in the latter; but the general character is the same in both, and very slight changes would suffice to convert the one into the other.

In *Scrupocellaria* the avicularium is attached to the side of the zoecium by its entire length; but it is truly pedunculate (Woodcut, fig. xxxiii.), and if attached only by the base, would bear a close general resemblance to the *Bugulan* form. The mandible is curved in towards the extremity, and the beak is somewhat hooked; so that the appendage has considerable prehensile power. The chamber is not more than sufficient for the lodgment of the muscular fascicles.

Fig. xxxiv.



*Pedunculate avicularium
of
Bicellaria tuba.*

A still nearer approach to the higher avicularium occurs in the remarkable form described by Smitt under the name

Fig. xxxv.

*Membranipora princeps.*

Fig. xxxvi.

*Diachoris Magellanica.*

of *Membranipora minax* (Woodcut, fig. xxxv.)*. Here we have the perfect form of the "bird's head" (a curious

Fig. xxxvii.

*Avicularium of Notamia.*

to. Tactile organ. a. Aperture.
c. Chamber. s. Stem.

Fig. xxxviii.

*Cell of Notamia, with avicularium.*

anticipation of the organ as it exists in *Bugula Murrayana*): but there is no basal joint, and the whole structure is calcareous. A connexion is very clearly established

* This is certainly distinct from *M. minax*, Busk; and I should propose for it the name of *M. princeps*. Compare the fixed avicularium of this species with the movable bird's head of *Diachoris Magellanica* (Woodcut, fig. xxxvi.).

between the simply mamillated avicularium and the articulated through such forms as we have in the true *Membranipora minax* (Woodcut, fig. xxxi., *a*), in *Scrupocellaria ferox* (Woodcut, fig. xxxi., *b*), and the present species.

In *Notamia* we have probably the fixed form which comes, on the whole, nearest to the movable "bird's head," and constitutes the most direct link between the two classes of avicularium (Woodcut, fig. xxxvii.). Here the hollow portion (or chamber) is borne on a slender stem of considerable length, from which it is separated by a partition; it expands from the base upwards; and on the upper surface is placed the curved beak ("like that of a cuttle-fish"), occupying about two thirds of its length, at the base of which the mandible takes its origin. The latter is much curved, and terminates above in a sharp point. The upper edge of the chamber below the mandible surrounds a semicircular space, closed in by a membrane, which probably represents the aperture of the normal zoëcium. Two new features (both of them present in the "bird's head") make their appearance in this form. The beak and the portion of the wall of the chamber from which it rises are of horny material; in the lower forms they are calcareous. Between the mandible and beak, when the former is elevated, a tuft of minute setæ placed on a slight rising is visible, which constitutes a tactile organ, and conveys the external stimuli which bring the muscles into play. It is possible that this structure may exist in species in which it has not yet been observed; but so far, I believe, it has only been noticed amongst the higher forms (which I shall call the *articulated avicularia*) and in *Notamia* *. It may, I

* In all but its fixed condition *Notamia* agrees with the articulated group.

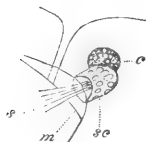
think, be concluded that it is the concomitant of the more highly specialized form.

I may add that the avicularia in *Notamia* have very much the shape and general appearance of zoœcia reduced in size, and are placed, like the latter, in opposite pairs.

We pass now to the articulated forms, in which the zoœcial type is completely masked, its elements being so modified as to constitute an elaborate prehensile appendage, charged with a special service in the interests of the colony (Woodcut, fig. xxviii.).

In the articulated avicularium the “bird’s head” is supported on a short peduncle with a basal joint, on which it sways to and fro. The head is composed of two portions,—a lower, which is more or less rounded above, and forms the *chamber* for the muscles (=the cavity of the zoœcium), and an upper or anterior, which consists of a movable mandible and a curved beak opposed to it. This anterior portion is formed of horny material, whilst the chamber itself is calcareous. The walls of the projecting upper

Fig. xxxix.



Rudimentary Polypide in Avicularium.

c. Cellular body. *sc.* Setiferous cup. *s.* Setæ. *m.* Membrane closing orifice.

jaw, which terminates in the hooked beak, inclose an aperture, over which stretches a delicate membrane, pierced by a small circular orifice. This aperture represents the

mouth of the zoecium, the mandible taking the place of the operculum. Within the chamber occurs a small circular body, composed of distinct cells, which is connected (in *Bugula flabellata**) with a cup-shaped organ, opening out through the membrane of the aperture. From the bottom of the cup rise a number of setæ, which project beyond the opening and constitute the tactile organ before referred to †. The cellular body (Woodcut, fig. xxxix., c), in connexion with the setiferous cup, has been regarded as a nervous ganglion (Busk, Smitt); the two together constitute, according to Nitsche, the homologue of the polypide, which is here reduced, in conformity with the altered significance of the whole structure, into a mere organ of touch. There can be little doubt, I think, that the latter is the true view; at the same time it must be regarded as probable that the rudimentary polypide is furnished with its nerve-centre, by which the powerful muscular apparatus ‡ and the sensitive organ may be supplied. Whether the cellular body constitutes the ganglion, we are not at present in a position to decide. The articulated avicularia are always attached to the wall of the cell, and usually at a short distance from the orifice; they are confined (apparently) to a comparatively small number of genera.

Some further evidence of the morphological nature of these curious appendages may be briefly noticed. (i.) In

* According to Nitsche, "Ueb. die Morphologie der Bryozoen," Zeitsch. f. wissensch. Zool. xxi. 4 Heft, p. 111.

† According to Busk this organ is protruded by the mere throwing back of the mandible. When the avicularium is opened, it stands out prominently on the upper surface.

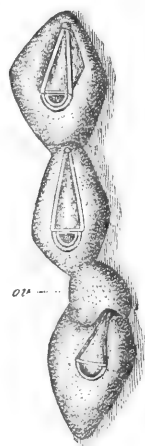
‡ The muscles are disposed in two sets—one for the opening and the other for the closure of the mandible; they are composed of transversely striated fibres.

some cases I have met with ovicells developed over the upper extremity of the avicularian beak and mandible, clearly indicating their morphological relation to the orifice of the zoëcium. On more than one occasion this *lusus* has occurred to me in *Schizotheca fissa* (Woodcut, fig. xl.)*.

(ii.) The resemblances in minute detail between the avicularian cell and the ordinary zoëcium of the species to which it belongs, which are not unfrequently met with, have a like significance. Thus, to take a single illustration, in one species a minute sinus occurs on the lower margin of the avicularian mouth, corresponding with a similar sinus in the orifice of the zoëcium. Instances of the same kind might be multiplied.

The function of the avicularia is difficult to determine ; nor, indeed, can the same function be assigned to all of them. The primary forms are many of them quite unfit for prehensile work. The lid-like mandible, with plain rounded margin, has no power of grasping, and could not detain for a second the active worms which are sometimes captured by the articulated kinds. Their service for the colony must lie in some other direction. Even the fixed, transitional forms, in which the beak and curved mandible are present, must be inefficient for this work from their want of mobility, whilst in many of them the parts concerned in the act of prehension are but slightly

Fig. xl.

Avicularian cells.
ov. Ovicell.

* Another case is recorded on p. 240.

developed. The articulated avicularia, however, are undoubtedly grasping organs*; and the presence of the tactile tuft between the jaws must be taken to indicate that capture in some form or other is their function. They have been seen to arrest minute worms, and hold them for a considerable time with a tenacious grip, as if with some ulterior object; but what the object may be it is difficult to decide. Dr. Johnston suggested that they may assist in providing supplies of food, seizing "circumfluent animalcules," and retaining them until, "enfeebled or killed by the grasp," the ciliary currents may bear them to the mouth. But the avicularium is not fitted to capture the extremely minute organisms on which the polypides feed; and even could they be captured and rendered helpless, there would be many chances, placed as the appendages usually are, against their coming within the attraction of the ciliary vortex. The worms, which seem to be the commonest victims, could only be utilized as food by being retained until, decomposition having set in, the particles of decayed matter might diffuse themselves through the surrounding water, and find their way, in greater or less degree, to the stomachs of the polypides. But the supplies of nutriment in the water of the ocean must be ample and unfailing, and no better provision for appropriating them than the ciliary whirlpool can well be imagined. Unless we can suppose that a peculiar diet is necessary for the species furnished with the prehensile appendage, it is hardly probable that the ordinary arrangements would have to be supplemented by the service of such uncertain purveyors. And should they be feeders

* "When touched with a needle the beak generally seized the point so firmly that the whole branch might be shaken."—DARWIN.

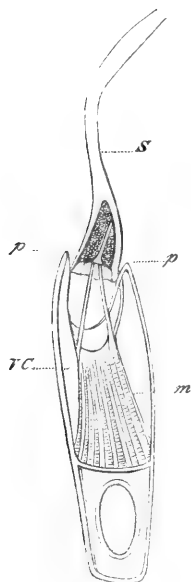
on dead organisms only (as has been suggested), they would certainly lead a precarious existence if dependent on the chance supplies of the avicularian commissariat. The appendages, it must be remembered, have no freedom of movement; they do not go in quest of prey; they merely oscillate without variation to and fro, snapping their jaws at haphazard, or when roused by some irritation of the tactile setæ. Their captures must be fitful and uncertain; and if the food requires long keeping to be fit for use (and under the conditions this seems to be a necessary supposition), the colony must be in chronic danger of a famine. If *living* animals be the required diet, then the cilia are adequate to the supply of them, and the avicularia are not.

On the whole (though the question is certainly involved in much obscurity), I am inclined to regard the avicularia as charged with a defensive rather than an alimentary function. They may either arrest or scare away unwelcome visitors. Their vigorous movements and the snapping of their formidable jaws may have a wholesome deterrent effect on loafing Annelids and other vagrants, whilst the occasional capture of one of them may help still further to protect the colony from dangerous intrusion. On this view of them, they have a function analogous to that of the other appendage with which the *Cheilostomata* are furnished.

The *Vibraculum*, though morphologically related to the zoecium, like the avicularium, is more immediately connected with the latter; and we find a line of transition forms linking the two together. It consists, in its more perfect condition (Woodcut, fig. xli.), of a chamber, in which the muscles are lodged, and a movable bristle, sus-

pended in a kind of cleft at its upper extremity, in which it works backwards and forwards. The seta (or bristle)

Fig. xli.



Vibraculum of Scrupocellaria seruposa.

V.C. Vibracular chamber. *m.* Muscles. *p p.* Pointed extremities of the chamber, between which the seta is suspended. *S.* Seta.

is broad at the base, and above it slender, and often of considerable length. In some cases it attains an enormous development, and forms either a whip-like appendage or an organ of such a size and strength as to be available for locomotive purposes. On the lower part of the wall of the chamber there is always a small opening, marking the point from which a long tubular appendage (or radical fibre) originates (Plate VI. fig. 8, and Plate VII. fig. 2).

The vibraculum, as already mentioned, is of compara-

tively rare occurrence. In its most highly specialized forms, it is placed on the dorsal surface of the zoecium, and the movable seta (which when at rest is laid back upon the chamber) is swung round at intervals to the front of the cell, sweeping slowly over the surface as if to remove all noxious matter, and then returns to its original position. This movement goes on uninterruptedly during the life-time of the colony; and there can be no doubt that its object is to clear away dangerous intruders or accumulations of refuse from the neighbourhood of the orifice.

We have no difficulty in recognizing the equivalent of the avicularian mandible and the operculum of the cell in the seta. The mouth is here modified in the same sense as the rest of the structure: the raised "beak" is absent, being no longer useful; but the margin is carried out above into two prominent points, just within which the bristle is articulated, clear of all hindrances, and so as to possess the utmost freedom of movement (Woodcut, fig. xli. *pp*).

The homology of the parts becomes more evident when we study the transitional forms. We meet with a developmental stage (corresponding to the *primary avicularium*), in which the vibraculum is developed on the original plane of the colony, and occupies the position of an ordinary cell; in some species the vibracular cells alternate regularly with the zoecia. In such cases the movements of the seta are of necessity much restricted, and the appendage is rather a servant of the colony than of the individual polypide (Plate XXI. fig. 7).

The direct links between the vibraculum and avicularium are found in those forms of the latter in which the

mandible is prolonged and attenuated, whilst the beak is almost rudimentary. Indeed it is difficult to draw the line between them, unless we regard the total absence of a distinct beak as the essential characteristic of the vibraculum. We have a case of the slight extension and attenuation of the mandible in *Schizoporella spinifera* (Plate XXXV. fig. 7); in *Membranipora ciliata* the change is occasionally carried still further; but there is great variability, and the mandible is now of the ordinary form, and now prolonged into a vibracular process (Plate XXVIII. fig. 8). In *Schizoporella vulgaris* the mandible is metamorphosed into a seta, but the beak survives, and the movement is probably nothing more than the rising and falling, as of a lid. In *Mastigophora Hyndmanni* (Plate XXXVII. fig. 5) the mouth is so modified as to give much more play to the seta, which is thrown backwards and forwards with perfect freedom, and has much the appearance of a lash. In this species the vibraculum is borne on a distinct cell, resembling the zoecium (on which it is developed) except in size. In yet another case the vibracular cells are still further reduced, and one is placed on each side of the orifice of the zoecium (Plate XXXVII. fig. 1). When we come to the higher forms we meet with cases in which the seta resumes the dimensions of the mandible, and loses its free and vigorous swing (Plate VI. fig. 8).

The most elaborate form of this appendage is found in the genus *Caberea*. There the chamber is large, and traversed on the upperside by a channel or groove, in which the seta lies when at rest*. The latter is of great length, and ser-

* This groove must be regarded as a modification of the aperture, *i. e.* of that portion of the front wall of the cell which, in *Caberea* and many other forms, is filled in by membrane.

rated or toothed along the edge. In this genus the entire dorsal surface of the branch is covered by the vibracula, and the movements of the setæ are synchronous; they act together with perfect regularity—the whole company on a branch swinging to and fro at the same moment, and as if under a common impulse (see page 58). We can hardly doubt that there must be some intercommunication between the nerve-centres of the individual vibracula, on which these combined movements depend; but so far the synchronism has attracted very little attention*, and we have no observations that throw any further light upon it.

The setæ attain their highest development in the family of the *Selenariidæ*, Busk: here they are of enormous size and of great strength, and assume, in some species at least, a locomotive function, acting probably as oars, and propelling the colony, which is free in the adult state. In the history of these appendages we have a curious illustration of the variety of function that may connect itself with the same morphological element†.

* It was first observed by Mr. Darwin in a species of *Caberea* ('Voyages of Adventure and Beagle,' vol. iii. pp. 259–262; 'Origin of Species' (later editions). I have also studied it in *Caberea Boryi*.

In the passage referred to Mr. Darwin also states that the *avicularia* on one side of a branch were observed to move, "sometimes coinstantaneously, sometimes in regular order, one after the other."

† Salensky finds in the vibraculum a structure homologous with the polypide, corresponding exactly with that in the avicularium.

The *avicularia* were first noticed by Ellis; they have been investigated by Nordmann ('Fauna Pontica'), Krohn, Van Beneden ("Recherches," Mém. Ac. R. Belg. vol. xviii.), Reid (Ann. & Mag. N. H. vol. xvi. p. 385), Darwin (*loc. cit.*), Busk ("On *Notamia*," Trans. Micr. Soc. Oct. 27, 1847; "On *Avicularia* and *Vibracula*," vol. ii. p. 26), Smitt (Öfvers. Vet.-Ak. Förh. 1867, p. 468), Nitsche (Zeitsch. xxi. Heft 4, p. 110).

THE POLYPIDE OF THE ENTOPROCTA.

In the group of the *Entoprocta* the polypide differs so widely and essentially in structure from that of the *Ectoprocta* that it is necessary to treat it separately. Its chief peculiarities, however, are described elsewhere (pages 563, 564); and I need only add that the importance of the characters on which the new division is founded has been generally recognized*. For an account of the aberrant group of the *Pterobranchia* the reader is referred to the systematic portion of this work (pp. 577-580).

ORGANS OF SENSE.

Special organs of sense are of rare occurrence amongst the Polyzoa; and such as exist are of the simplest kind. With a single exception they are all tactile in function, and very similar in structure.

The most elaborate occur in the genus *Loxosoma*, and consist of papillæ, placed one on each side of the body of the polypide, bearing on the summit a number of rigid setæ. The papillæ are contractile, and can be almost wholly withdrawn†; their cavity, according to Salensky, is occupied by a nerve-knot, which is connected by nervous filaments with the central ganglion. The setæ

* An extensive literature has sprung up devoted to the *Entoprocta*. See Nitsche, "Ueber *Pedicellina echinata*," Zeitsch. wissensch. Zool. xx. (1870), Heft 1; "Ueb. den Bau, &c. von *Loxosoma Kiefersteinii*," ibid. xxv. p. 451; Schmidt, O., "Die Gattung *Loxosoma*," Arch. f. mikr. Anatomie, xii.: C. Vogt, "Sur le *Loxosome* des *Phascosomes*," Arch. de Zool. expérimentale, 1877 (transl. in Quart. Journ. Micr. Sc. (n. s.) vol. xvii. p. 353): Salensky, "Études sur les Bryoz. Entoproctes," Ann. Sc. Nat. 6^e sér. Zool. v. (1877), article no. 3: Hatschek, "Ueb. *Pedicellina*," Zeitsch. xxix. p. 502.

† Vogt describes the papillæ as containing "elongated, conical, converging cells, apparently in direct communication with the bristles." He failed to detect the nerves.

are in contact with the knot*. These are clearly organs of touch, similar to those which occur in many other animals. Salensky compares their structure to that of the antennæ of the Rotifers.

Closely allied to these sensitive papillæ are the tactile tufts, which occur in the articulated avicularia, and which have been already described. In the same category may be placed the bristles which form a line along the back of the tentacles in many species. These are probably analogous to the palpocils of the Hydroida, and must largely increase the sensitiveness of the corona, through which the polypide communicates with the outer world.

An interesting provisional organ has been noticed by Salensky in the young of *Loxosoma crassicauda*. The arms of the budding polypide are furnished with a very long motionless bristle, placed on the external side, near the top, which disappears at a later stage. He regards it as a tactile organ, needful to the young after its detachment, when seeking a site for fixation, but useless to the adult.

In the larva of *Loxosoma* Vogt describes an organ composed of two circular hollows, surrounded by a thick border, which forms a kind of bridge between them. Within each depression are placed five or six conical papillæ, supporting long cilia, which can be exerted or withdrawn into the hollow. He names it the "spectacle-organ;" and from its similarity of structure we may infer that it has the same function as the preceding, though it is difficult to determine its precise relation to the economy of the larva.

* Salensky, "Études sur les Bryozoaires Entoproctes," Ann. Sc. Nat. 6^e sér. Zool. vol. v. (1877), article no. 3.

We may probably also rank amongst the organs of sense, though of a very humble and rudimentary kind, the coloured specks, frequently inclosing a refractive corpuscle, which occur on many of the Polyzoan larvæ. They are sometimes numerous (as in *Bugula flabellata*, Plate LXXXIII. fig. 6)*, and may perhaps be regarded as primitive eyes.

REPRODUCTION AND EMBRYOLOGY.

Two kinds of reproduction have a place in the life-history of the Polyzoa, a sexual and an asexual—(i) reproduction by means of ova and spermatozoa, and (ii) by gemmation †.

In a large proportion of cases the species seem to be monœcious, both male and female organs being present in each cell. But the rule is not without its exceptions. *Alcyonidium gelatinosum*, according to Kölliker, is unisexual; and I believe the same to be the case with *A. mytili*. In this species the ova are produced in gonœcia (that is, in cells destitute of a polypide and devoted to reproductive functions), whilst in some of the ordinary zoœcia the spermatozoa occur in enormous quantities: I have seen them darkened by the dense mass of wriggling filaments which filled the perivisceral cavity. Such cells were provided with the ciliated intertentacular organ (to be described hereafter); and through this the spermatozoa were finally discharged into the surrounding water. In this case it would seem probable that the sexes are distinct;

* Nitsche, "Ueb. die Entwicklungsgeschichte einiger chilostomen Bryozoen," Zeitsch. f. wissensch. Zool. xx. Heft 1, p. 7 (sep.).

† Sexual elements have not yet been observed in the *Cyclostomata*.

but I have not been able to determine the mode in which the fertilization of the ova is effected.

Joliet has observed the separation of the sexes in a *Lepralia*; and, according to Vogt, *Loxosoma phascolosomatum* is unisexual; whilst in *Tendra*, according to Rapiachoff*, some of the cells in a colony are hermaphrodite, but the greater number of one sex only.

The origin of the reproductive elements and their position in the perigastric cavity have already been discussed in the account of the endosarc (pp. xlvii-l).

The spermatozoa are formed out of the nucleus, which occurs in each of the vesicles included in the sperm-cell; and consist of a thread-like body, which is occasionally vibrioid, but more commonly somewhat enlarged at one extremity†. They have an undulatory movement; and in some cases I have noticed a violent shaking of the clavate head.

It is a question whether the ova are fertilized by spermatozoa developed in the same cell with themselves, or whether the office is discharged by those which are liberated from other cells. Joliet has adopted the latter view, and supported it by a number of observations, which appear at least to show that in some cases the spermatozoa are entirely cleared out of the zoëcium before the ova have reached the stage for fertilization. The very fact, too, that they are sometimes ejected in such immense numbers into the surrounding water (where they seem to live and thrive), may be taken to prove that they have a

* Zeitsch. f. wissensch. Zool. xxv. p. 129.

† Both Farre and Van Beneden describe them as having in some cases a rounded or discoid head; and the former states that by this they occasionally fix themselves.

function to discharge beyond the precincts of their birth-place. In some instances, too, Joliet has been able to obtain direct evidence of the fertilization of the ovum by extracellular spermatozoa. But though in certain species this method may prevail, we have no reason for supposing that it is general. In *Bugula avicularia* I have observed the spermatozoa swarming round the ovary, which was situated on the funiculus immediately below the extremity of the cæcum; and it can hardly be doubted that in this case fertilization was effected either before or immediately after the escape of the ova. In most of the cells eggs in various stages of development were present. In *Farrella* Van Beneden describes the ova as passing from the ruptured ovisac into the cavity of the cell, and being there surrounded on all sides by the spermatozoa. In *Bicellaria ciliata* Nitsche has found the ovum fertilized whilst still within the body-cavity, and before its transference to the oœcium; and in this case there can be no doubt that impregnation was due to the spermatozoa of the cell in which it occurred. We should draw the same inference from Smitt's account of the reproductive elements in *Scrupocellaria scruposa**. In *Paludicella*, according to Allman, the spermatozoa liberated from the testicle at the bottom of the cell may be seen clustering round the ovary at the top of it. We must, I think, admit that both modes of fertilization exist. Of course, in the case of unisexual species, the spermatogenic bodies must find their way from the male to the female zoœcia; and we can only suppose that they take the road through

* He says "Sådana svärma de [the spermatozoa] upp till den plats, der ännu ägget ligger kvar uti djurhusets öfre del" ('Om Hafsbrözoernas Utveckling,' p. 36).

the surrounding water. We might be tempted to conjecture that the enormous production of spermatozoa which sometimes occurs must be specially connected with the diœcious character of the species, or at any rate that in such cases the fertilization of the ova must be effected from without. But observations on this point are wanting.

Joliet states that in the case of several species he has seen the spermatozoa pass from the cell "through the delicate tissue of the tentacular sheath;" and he supposes that their expulsion may be due to the pressure of the perigastric fluid at the moment of retraction. In other cases we know that there exists a special means of egress—the "intertentacular organ," which was first noticed by Dr. Farre*, though he failed to determine its place in the economy. He observed it in *Alcyonidium gelatinosum* and *Membranipora pilosa*; I have also met with it in *Alcyonidium mytili* and *Membranipora membranacea*. It consists of an oblong flask-shaped body, which is placed between two of the tentacles, and attached to the tentacular ring; its interior is occupied by a cavity lined with cilia, "which vibrate downwards towards the outer and upwards towards the inner side;" and at the upper extremity there is a wide circular orifice surrounded by cilia. There is sometimes a constriction a little below the top, so that the upper portion forms a cup-shaped compartment. The organ is closely united to the sides of the tentacles, and is placed on the anal aspect of the body; below it opens into the perigastric cavity. It is not present on all the polypides in a colony, and is often

* Philosophical Transactions for 1837, pp. 408 and 412. See also "Notes on British Zoophytes," by the author, Ann. & Mag. Nat. Hist. for November 1851.

absent altogether; in some cases it occurs in great abundance*.

As I have already stated, this organ is the channel through which the immense numbers of spermatozoa, congregated in certain cases and at certain seasons in some of the zoœcia, find their way into the water. I have watched them streaming up incessantly from the lower part of the cavity for three or four minutes, the filaments as they reached the base of the organ being drawn into it and carried through it by the action of the cilia, and then ejected and borne away by the tentacular currents. After a while a single filament made its appearance occasionally; and at last none were to be seen. This swarming of the spermatozoa is really an extraordinary sight; and the numbers expelled in the course of it must be immense.

At other times I have repeatedly seen a mass of excrementitious matter pass into the organ from below, which was gradually forced upwards by the cilia, and at last ejected, as a pellet, through the terminal orifice. This, I confess, surprised me not a little, as in some cases in which the organ was present the fæcal matter was seen to pass outward in the usual way through the anal opening. I was at one time inclined to regard this curious appendage as denoting a difference of sex; but as I have met with it

* Ehlers suggests that this intertentacular organ may be nothing more or less than a parasite, as he had himself noticed a very similar structure on a *Lepralia*, which he had ascertained to be an infusorium! We may safely conclude that he contented himself with referring to my paper, and dispensed with the reading of it, as it would be difficult to harmonize the very precise description which it contains of the passage of the spermatozoa through the cavity of the organ with any such hypothesis.

The curious structure which he has himself noticed as occurring on *Hypophorella* (*op. cit.* p. 56), and which has no doubt an excretory function, may very probably bear some analogy to the organ which he has too hastily dismissed as apocryphal.

in a zoœcium containing ova (in *Membranipora membranacea*), I now consider it to be an excretory organ, which serves at the swarming-season as the passage by which the spermatozoa escape from the cell into the surrounding water (= the *nephridium*, Ray-Lankester).

The ovary, as we have seen, varies in position ; it also varies remarkably in size. In some species it contains a large number of ova (thirty in *Hypophorella*, and probably an equal number in *Farrella*), in others only one or two. Frequently two ova are produced, which are either matured in succession, or one of them perfects its development at the expense of the other, which is atrophied. It appears that in some cases, after the first ovary (on the funiculus) has discharged its contents, it is followed by a second. In its early stage the funicular ovary is a minutely granular body, of an oval form, and a pale golden colour (Woodcut, fig. xxiv. *ov*). In its interior the ova make their appearance, and, when mature, consist of a granular yolk (*vitellus*), which is sometimes coloured, invested by a membrane, and presenting a conspicuous germinal vesicle, with a germinal spot. At a certain stage they escape through the ruptured wall of the ovary into the perigastric cavity. After fertilization they exhibit the usual phenomena of segmentation, and are developed into free, ciliated larvæ.

An interesting question arises, as to the mode in which the embryo, imprisoned in the zoœcium, makes its escape into the outer world ; and this connects itself with the history of the structure known as the *oœcium* or ovicell. This is a small, somewhat globose or galeriform receptacle, which in many species of *Cheilostomata* is developed during the breeding-season, at the upper extremity of the

cell. It is usually, but not always, terminal, and is produced by gemmation from the wall of the zoœcium; its interior is in direct communication with the perigastric cavity. In certain species (e. g. *Bicellaria ciliata*), the oœcium exhibits a somewhat complex structure. The opening is closed by a membranous capsule (attached by its base in front), which partially occupies the cavity. This capsule is furnished with museles, by which it can be more or less withdrawn from before the orifice, so as to allow of the escape of the larva. The ovum, when transferred to the ovicell, lies between its outer wall and the capsule. By the action of the retractor muscles, the membranous wall of the capsule can be drawn down, so as to leave a larger space for the embryo as it increases in size, as well as secure a passage for it when mature*.

At the time when the reproductive elements are present in the cells, ova are commonly found in the oœcia, where they occur in every stage, from the first segmentation to the perfect larval condition. Huxley was the first to suggest † that the ovicell must be regarded as a kind of marsupial chamber, into which the ova migrate from the zoœcium for the purpose of completing their development; and this view has met with general acceptance. I was at one time led, by observations which I had made on a number of species, to challenge it, and to contend that the ovum found in the ovicell was produced there, and was not a mere emigrant; but, as I have already explained ‡, I am now convinced that the marsupial theory

* The structure and development of the ovicell have been admirably demonstrated by Nitsche (Zeitsch. &c. xx. 1. Heft, pl. i. figs. 10, 11).

† Quart. Journ. Micr. Sc. iv. (1856), p. 191.

‡ "Contributions to the History of the Polyzoa," Quart. Journ. Micr. Sc. (n. s.) xiii. p. 30.

is unaffected by those observations. There can be no doubt that the ova generated in the zoëcium do pass into the ovicell and there ripen into the perfect larva, escaping at last through its orifice. The oëcium is thus both a brood-chamber and the passage for the embryo from the cell to the surrounding water.

But whilst I have no doubt that the ovicell acts as a kind of marsupium, there seem to me to be grounds for believing that in some cases, and under conditions which I cannot explain, *ova are also produced within it*. Reid long ago described the oöcial ova as adhering in their earliest stage to the lining membrane at the upper end of the capsule. I have repeatedly observed in the ovicell a minute and somewhat indefinite mass of granular substance in contact with the membrane at the top of it, which had all the appearance of a nascent ovum; the first change seemed to consist in a slight concentration of the matter towards the centre of it. In other ovicells there was a small circular body; in others the ovum had increased in size, and exhibited the various stages of segmentation. Smitt has also recorded the formation of ova within the oëcium. In the case just referred to, the very small size and rudimentary condition of the ovum in its early stages seem to show that it must have been something different from the ovum developed in the cell, which is perfectly formed and of considerable size when it passes into the marsupium. The subject must be left for future investigation.

The direct passage of the ova into the oëcium has not been witnessed; nor have we, I believe, any observations showing by what means it is effected. They are some-

times met with, however, at a very short distance from the entrance to the marsupium. In a specimen of *Flustra papyracea*, in which ova were present (in some cases near the bottom of the zoëcium, in others higher up in it, in others, again, close to the opening into the oëcium), I observed one jerking itself spasmodically, as if it might be freeing itself from the investing envelope; and after repeatedly witnessing its vigorous movement, I could have no doubt that it might pass by means of the contraction and extension of its substance from the cell to the ovicell.

In species which are not furnished with the marsupium, other means of egress must exist. In some cases the embryo is probably liberated after the disappearance of the polypide, of whose destruction it may perhaps be the cause. In *Vesicularia spinosa* I have found the mature rose-coloured larva in the tenantless zoëcium equipped with its cilia and ready for escape.

In one or two forms a special opening has been detected, near the base of the tentacles, through which the ova pass. Van Beneden was the first to notice this in *Farrella**; and recently Ehlers has detected a similar orifice, placed in much the same situation, in *Hypophorella*†. In the case of *Farrella* the ova seem to escape at a very early stage of development, and before the appearance of cilia.

But the most remarkable provision for the liberation of the embryo remains to be noticed. For our knowledge of it we are indebted in the first instance to the observa-

* Mém. Acad. Roy. Brux. xviii. "Rech. sur l'organisation d. *Laguncula*," p. 18 (sep.), pl. i.

† *Op. cit.* p. 66.

tions of Metschnikoff* and Nitsche† on the Freshwater Polyzoa; whilst Joliet has recently detected the same or a strictly analogous arrangement in some of the marine species ‡. I shall give a brief account of it (after this writer), as it exists in the latter. In cells of *Valkeria* from which the polypide has disappeared (being replaced by a "brown body"), a mature ovum is met with at certain seasons, not yet fertilized, and, as it seems, hopelessly imprisoned in the closed cavity of the zoecium. But at the moment when escape appears least likely, a bud makes its appearance at a certain point on the cell-wall (in connexion with some offshoot of the funiculus), which is rapidly developed into a young polypide. The latter passes to the top of the cell and develops new parieto-vaginal muscles and two great retractors, but otherwise remains in a perfectly rudimentary condition. It is to be imagined now as being in connexion with the tentacular sheath and, through the funiculus, with the ovum.

The funiculus shortens, and the sheath is proportionately elongated; and the polypide is thus brought into contact with the egg: in a short time (but by what precise means is unknown) the latter makes its way within the tentacular sheath, and occupies a place above the polypide. The latter dwindles away and becomes a mere platform (movable by means of its attached muscles), on which the ovum rests, inclosed by the walls of the sheath. It is now in free communication with the water; and at

* Bull. de l'Acad. de St. Pétersbourg, xv. (1871), p. 507.

† Zeitsch. f. wissensch. Zool. xxii.

‡ *Op. cit.* p. 70. This author seems to have been unaware of Metschnikoff's previous observations. He has noticed the "auxiliary polypide" in three Ctenostomatous species,—*Valkeria uva* form *cuscuta*, *Bowerbankia imbricata*, and *Lagenella repens*.

this stage (according to Joliet) it is fertilized by passing spermatozoa, and immediately enters on its further development. At this time its behaviour is in many respects that of a polypide. Thanks to the muscles which it has borrowed, it now rises to the entrance of the cell and now retreats to its recesses, until, having assumed its perfect larval form, it passes through the sheath into the water. The "auxiliary polypide" has discharged the functions of an oöcium, and has both supplied the ovum with a brood-chamber and a way of escape. In its leading particulars, this marvellous history rests on the authority of three able observers.

The true marsupium seems to be confined to the *Cheilostomata*, and even amongst them is by no means universal. In other sections of the class ova are frequently developed in special receptacles, and not in the zoöcia: to these I have given the names *gonöcium* and *gonocyst* *. Of the former we have a good example in the genus *Crisia* †; it also occurs amongst the *Cheilostomata*, and in one family at least (*Alcyonidiidæ*) of the *Ctenostomata*. The gonocyst has only been noticed in certain Cyclostomatous genera; it is probably only a modification of the gonöcium. Of the history of these structures, however, we know little; they remain to stimulate and reward further research.

I do not propose to follow the ovum through the stages of its development; nor shall I enter minutely into the numerous modifications of the larval form. To do so

* See Terminology, page iii.

† Smitt has investigated the gonöcium of *Crisia*, and considers the production of ova in it to be asexual. 'Om Hafsdyrzoernas Utveckling,' &c. (1865), p. 19. For a critical notice of Smitt's observations, see Barrois, 'Embryologie' (1877), p. 59.

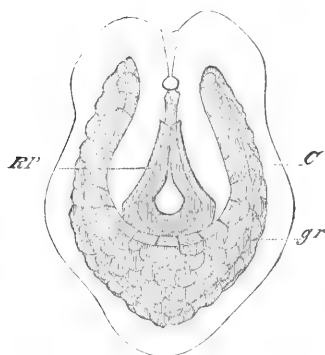
with the necessary thoroughness would require a much larger space than I have at my command. I must content myself with referring the student for detailed information on these branches of the subject to the works of Allman, Smitt, Nitsche, Metschnikoff, Claparède, Hatschek, Vogt, Salensky, Repiachoff, Joliet, and (chiefly) Barrois *, who has specially devoted himself to this department, and has given us, in a splendid monograph, a series of admirable and exhaustive researches.

The larvæ, which are developed from the ova, and give rise to the first term of the polyzoan colony, present many varieties of form and a somewhat complex structure (see Plate LXXXIII.). The figures on this Plate will give some idea of the singularity of shape, the beauty of colour, and the profusion of ciliary and flagellate appendages which they frequently exhibit. The forms represented in figures 9 and 10 are also furnished with a delicate bivalve shell. The larvæ are restless in their habits, and during their short term of free existence are in almost constant movement, now whirling rapidly hither and thither, now tumbling over and over in the water, now creeping along, making use of their cilia as feet. Besides their ciliary appendages, they are often furnished with long setiform processes, which wave to and fro, and lash the water with much vehemence. After a while their energies fail, and they settle down and become attached; the cilia begin to flag in their movements, and soon disappear; and the volatile and curiously organized being resolves itself into a fixed and (apparently) homogeneous mass, in which the first zoœcium and polypide originate.

* The titles of the respective works will be found in the Bibliographical List at the close of this volume.

What, then, are the extent and significance of the change which takes place in the larva after its fixation? It has generally been held that in most cases the complex organization which characterizes it in its free condition suffers complete histolysis after its attachment, and is replaced by a mass of structureless material, inclosed by a membranous envelope. This was the view taken by Schneider in his account of the remarkable larva of *Membranipora pilosa**, and adopted by Nitsche, Joliet, and others. According to the later observations of Barrois, however, this is by no means a correct representation of the actual fact. What really occurs is not an utter dissolution of the larval organism, but merely loss of a special larval organ, which disappears after fixation, as

Fig. xlii.



Cell of Schizoporella shortly after fixation.

C. Cell. *gr.* Granular mass, result of histolysis of the corona.
R P. Rudiments of polypide.

the tail of the Ascidian larva undergoes histolysis when it becomes attached. The organ which, according to Barrois, is the starting-point of the histolysis amongst

* Sitz.-Bericht. d. Gesellschaft naturf. Freund. zu Berlin, 1868.

the Polyzoa, is the ciliary wreath or corona (Woodcut, fig. xlii.).

The other portions of the larval structure are destined to pass into the adult organism, the *aboral face* always constituting the zoecium, and the *oral* penetrating into the interior to form the rudiments of the principal internal organs *.

Claparède had previously criticised the views of Schneider and Nitsche respecting the complete dissolution of the larva, and had maintained that in the case of *Bugula* the retrogressive change limits itself to the loss of the cilia and the "whip," or tuft of setiform appendages †.

If Barrois's view be correct (as we have every reason to believe), we get rid of the anomaly that would be involved in the reduction of the complex larval structure to a mere homogeneous mass. We have to do with an ordinary case of metamorphosis: certain elements of the larval form, it is true, are histolyzed, and give rise to a mass of granular matter; but this in nowise prevents the passage of the organs of the larva into those of the adult.

In the case of the *Entoprocta*, the general opinion has been that the larva passes directly into the perfect animal; the observations of Van Beneden ‡ and Uljanin § seemed to leave little room for doubt. In the larva of *Pedicellina* the internal organs are very fully developed, as they exist in the adult; even the rudiments of the reproductive organs and of the brood-chamber are said to be

* Comptes Rendus, 23 Sept. 1878.

† Zeitsch. f. wissensch. Zool., Dec. 1870.

‡ 'Recherches,' &c., Mém. Acad. Roy. Belg. xix. pp. 80-82.

§ "Zur Anatomie u. Entwicklungsgesch. d. *Pedicellina*," Bull. Soc. Imp. d. Naturalistes de Moscou, xlii. (1869) p. 435. See also Vogt on *Lorosoma*, 'Archives de Zool. expérimentale,' 1877; translated by the author, Quart. Journ. Micr. Sc. (n. s.) xvii. p. 366, note.

distinguishable. As Vogt has remarked, "it is difficult to imagine that all these organs thus definitely constituted are to disappear that a new and similar set may be evolved." Van Beneden's observations are especially precise; and I had always regarded them as conclusive. Barrois, however, is of opinion that the cycle of development is the same for *Pedicellina* as for the Cheilostomes; and he has recorded observations which, so far as they go, seem to sustain this view. Subject to further investigation, his conclusion is that histolysis takes place in *Pedicellina* as in the other Polyzoa, and that the passage from the larva to the adult is less direct and simple than has been usually supposed. We must await the results of a fuller study of the question.

Putting out of view the case of the *Entoprocta*, it seems probable that the larva of the Polyzoa after fixation always undergoes a partial histolysis, affecting especially the provisional structures belonging to its free life, and passes by gradual metamorphosis into the perfect animal*.

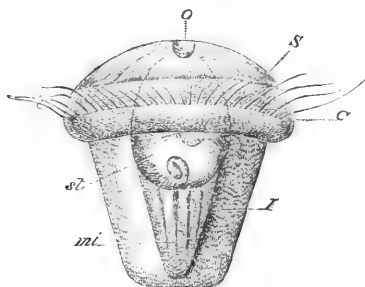
As the result of his extended researches into the embryology of the Polyzoa, Barrois reduces the various larval forms to a single primitive type, consisting of a *gastrula* with

* Joliet, indeed, has suggested a different view. To him the larva may be considered as composed of a zoecium and a zooid (the homologue of the polypide), both of them modified with reference to the necessities of a free life—the zoecium more highly organized than in the adult, the polypide rudimentary. The histolysis of the larva he compares to that of the polypide in the ordinary cell. When the former is on the point of fixing itself, the zooid which it contains dwindles away just as the latter does, and disappears. The larva of *Pedicellina* is strictly comparable to that of the other Polyzoa; it consists of a zoecium and a contained zooid; but as the ordinary polypide in this case does not undergo histolysis, neither does the larval zooid; it passes into the adult form, which it very closely resembles ('Bryozoaires d. côtes de France,' pp. 85, 86). Of course, if the observations of Barrois are confirmed, they exclude this interpretation. For myself, so far as the *Entoprocta* are concerned, I await the results of further investigation.

two opposite faces, separated by the ciliary corona—one (the aboral), which is much the most voluminous, at the opposite end from the mouth, the other (the oral) bearing the buccal orifice at its centre, and capable of being so covered as to constitute a vestibule (Woodcut, fig. xliii.).

From this primitive form all the other larval types are easily derivable, according to Barrois; “so far as the first portion of their development is concerned, there is a perfect uniformity throughout the entire group”*. Provisionally he regards the three divisions of the *Entoprocta*, the *Cyclostomata*, and the *Escharina*† (of Smitt) as being three parallel modifications of an ideal primitive form (Woodcut, fig. xliii.). The Escharine larva (which

Fig. xliii.



Ideal primitive form of the Polyzoan group.

o. Mouth of the *gastrula*. *S.* Oral face. *I.* Aboral face. *C.* Corona.
st. Stomach. *mi.* Aboral mesoderm.

makes the *nearest* approach to this ideal primitive type) gives origin to two divergent and strongly marked modifications (with which it is connected by transition forms)—that of the *Cellularina* (Smitt) and that of *Cyphonautes*,—

* Barrois, ‘Embryologie,’ &c., p. 261.

† The *Escharina* of Smitt include almost the whole of the Cheilostomatous forms in which the zoecium has a solid calcareous front wall. His *Cellularina* embrace all the Cheilostomatous families which rank, in the present work, before the *Cellariidae* (p. 103).

and also to two minor and intermediate modifications, the one represented by *Alcyonidium*, and the other by the *Vesicularians*. This scheme of the larval relationships of the Polyzoa must, however, be regarded as purely provisional. Notwithstanding the admirable investigations of Barrois and others, we can only regard our knowledge of the embryology of the Class as being quite in its infancy; and though we may probably accept as conclusive the demonstration of the one primitive type, we must have a much larger acquaintance with the varieties of the larval form before we can safely proceed to trace the genealogy and map out the courses of development*.

GEMMATION.

The second mode in which reproduction takes place amongst the Polyzoa is by gemmation. Almost invariably the budding is continuous, resulting in the formation of a composite structure; in the single case of *Loxosoma* the gemmæ detach themselves from the parent, and are developed into solitary animals.

The formation of the bud is a subject of the highest interest; but it is one that can only be treated satisfactorily at length, and with the help of many illustrative figures. In this general sketch of the class, which is merely introductory to the systematic portions of the work, it would be impossible to do justice to it; and I must content myself with referring the reader to some of the best sources of information†.

* On the question of the histolysis of the larva after fixation, see Nitsche, *Zeitsch. f. wissensch. Zool.* xxi. 4 Heft, p. 59, note.

Metschnikoff must be ranked as one of the first to dissent from Schneider's doctrine as to the complete dissolution of the *Cyphonautes*-larva (*Nachr. d. Univ. Göttingen*, 1869, no. 12).

† Van Beneden, 'Recherches,' &c., *Mém. Acad. R. Belg.*: Allman, 'Fresh-water Polyzoa,' pp. 35-37: Smitt, *Öfvr. kongl. Vet.-Ak. Förh.* 1865, no. 1,

Smitt has raised an interesting question as to the precise nature of the buds which are developed from the margin of the zoarium, and give rise to the new lines of cells. Round the growing edge of the colony, in the incrusting forms, we find a membranous or subcalcareous expansion, which is divided by slightly raised lines into numerous areas (see Plate XXIX. fig. 3). On these partition-lines, as foundations, the side-walls of the new cells are ultimately built up. This expansion Smitt considers to be a colonial growth—a *common bud* (“*samknopp*”), which divides, and is developed into separate cells*. But the interpretation seems to me both antecedently more probable and more in harmony with the facts of the case, which regards each of the marginal areas, ultimately developed into cells, as derived from an individual zoecium†. The inclosed area is often of considerable length, and may divide *transversely* into several cells, or (sometimes) longitudinally into two; but in all cases it seems probable that it is in its origin a growth out of *one* of the older elements of the colony, not a mere segment of a common bud‡.

The mode in which the calcareous ectocyst or outer wall of the zoecium is formed is a point which has received less attention than it deserves. In many species

pp. 5–16: Claparède, Zeitsch. &c., xxi.: Nitsche, Zeitsch. xxi. 1871, Heft 4, p. 58; “Ueb. die Knospung, v. *Loxosoma*,” Zeitsch. xxv. Suppl.-B. Heft 3, p. 146: Hatschek, “Knospung der *Pedicellina echinata*,” Zeitsch. xxix. (1877) p. 517: Metschnikoff, Bull. de l’Acad. de St. Pétersbourg, xv. (1871) p. 507: Ehlers, ‘*Hypophorella*,’ p. 77: Vogt, On *Loxosoma*, Arch. de Zool. expérimentale, 1877: Salensky, “Études sur les Bryozoaires Entoproctes,” Ann. d. Sc. Nat. 6^e sér. Zool. v. (1877); Zeitsch. xxii. pp. 343–348.

* “Om Hafsbyrzoernas Utveckling,” Öfv. kongl. Vet.-Akad. Förh. 1865, no. 1, p. 6.

† See Nitsche, Zeitschrift, &c., xxi. 4 Heft, p. 66.

‡ At page 223 a different *mode of gemination* is described, which occurs in some of the Cheilostomatous species.

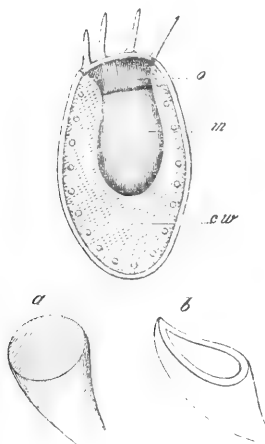
calcification is carried to a great extent, and proceeds with much rapidity; the cell is buried beneath a thick mass of stony matter, which in a short time obliterates its characteristic features, and completely changes its aspect. In such cases the original orifice of the cell is found to be placed at the bottom of a deep shaft, piercing the vitreous crust which has been piled on the surface. It is difficult to understand the mode in which this rapid accumulation of stony matter takes place, and the conditions which favour it. When the calcareous elements are discharged by immersion in acetic acid, the wall is represented by a thick stratum of animal matter. Physiologically the subject is of high interest, whilst to the systematist the effect of the calcification in modifying the characters of the species is a point of the first importance.

I shall add here an account of the development of the cell in *Mucronella coccinea*, one of the incrusting forms, so far as the external portions of the structure are concerned.

First stage.—Membraniporidan condition: a rhomboidal cell, with its aperture covered over by a flat membranous roofing. *Second stage.*—A delicate, transparent, membrano-calcareous arched covering, in course of development over the aperture from the bottom of the cell upwards, marked with transverse striæ. Before this has spread over half the front surface, four spines are developed at its upper extremity (Woodcut, fig. xlv.). *Third stage.*—Front wall completed, arching over the whole aperture, with the exception of a subcircular space at the top, which is left open; the membrane covering this free space takes on a decidedly corneous character, and constitutes the

oral operculum. Rudiments of two more spines, placed far forward, now make their appearance. *Fourth stage.*—Spines lengthening, denticles on the lower margin developed; mucro below orifice just beginning to rise. The avicularia marked out on each side of the orifice, consisting of raised hollow processes, subcircular, and covered in by membrane, resembling in general structure the early stage of the zoëcium.

Fig. xlv.



Young zoëcium of Mucronella coccinea.

o. Orifice. *m.* Portion of primary (membranous) covering. *cw.* Calcareous wall. *a, b.* Early stages of avicularium.

These four stages were exhibited by four neighbouring cells on the growing edge of a colony. The front wall in its earliest condition is of the most beautiful hyaline texture, and has a line of circular foramina round the margin. Further change in it consists chiefly of a gradual thickening, which culminates in a strongly granulose surface. (See Plate XXXIV.)

SPECIAL POINTS.—AFFINITIES.

i. *Relation of Zoecium and Polypide*.—As we have seen, each element of the Polyzoan colony consists of two parts, the cell and polypide. We have to consider briefly how these two are related to each other. Are we to regard them as constituting together an individual? or must we call them two zooids, associated, but individually distinct? According to the former view (which is the older), the polypide is an organ or collection of organs, the cell the enveloping sac, and their relation is the same in kind as that between any two ordinary portions of structure. Allman was the first to hold the true zooidal nature of the two parts; to him both the zoecium and polypide are individuals, the latter produced by budding from the former; and to this extent his doctrine has been generally accepted. But he pushed it still further, and contended that the ovary and testis, also produced by internal gemmation, are equally individuals, though of a humbler type. Nitsche* has pointed out the objections to this interpretation, and has insisted especially on the difficulty in the way of regarding the loose aggregation of sperm-cells, which constitutes the testicle, as the homologue of a distinct individual †.

We have no difficulty in recognizing the zooidal nature of the zoecium, when we follow its history, and find it able to live apart from the polypide, and even to survive several generations of polypides derived from its substance. Besides we meet with it under various forms, in some of which it is never associated with a polypide or

* 'Morphologie d. Bryozoen,' Zeitsch. &c. xxi. 4 Heft, p. 100.

† Hatschek disputes the zooidal nature of the zoecium and polypide; Repiachoff also rejects the doctrine of the distinct individuality of the latter: Zeitsch. &c. xxvi.

any representative of one. The internodes of the stem amongst the *Ctenostomata* are clearly homologous with the zoœcia; they are cells living as simple zooids. In the gonœcium we have the same morphological element discharging reproductive functions, without any help from the polypide*. The latter, on the contrary, seems to be always in connexion with a zoœcium; but the history of the cell shows clearly that we are not to regard the polypide as its organ, or in any sense an essential part of it. We can only, therefore, view it as an associated zooid; its own structure and habits forcibly suggest the same interpretation. An animal periodically losing all its internal organs and as regularly reproducing them would, indeed, be an anomaly. We are, then, to regard the zoœcium and the polypide as two *individuals*, one permanent, the other ephemeral, but capable of renewal, which compose together the primary element of the Polyzoan colony (the "polypocystid" of Nitsche)†.

ii. *Excretory Organs*.—It should be noted that very simple excretory organs occur in some of the Polyzoa, corresponding with those of worms, other Mollusca, &c. These are the *nephridia* (primitive kidneys) of Ray Lankester; and consist of minute ciliated tubes, passing from the body-cavity to the exterior, and forming a medium of communication between the two; they open out in the neighbourhood of the anus. They were first detected by Hatschek‡, in both the larval and adult forms of *Pedicellina*, and subsequently by Joliet§ in *Loxosoma*.

* The case of the gonœcium may be cited against the opinion maintained by Joliet, that the polypide and not the zoœcium (as commonly held) is the sexual zooid (*op. cit.* pp. 83, 84).

† The avicularium and vibraculum must also be accounted distinct zooids.

‡ Zeitschrift, &c. xxix. (1877), 4 Heft, p. 516.

§ Comptes Rendus. lxxxviii. (1879).

Ehlers has noticed the nephridium in *Hypophorella* (*op. cit.* p. 66); and I should place in the same category the intertentacular organ of *Alcyonidium*, &c., previously described, which, whatever its other functions, serves, at certain seasons, as a genital duct.

Salensky, in his account of *Loxosoma crassicauda**, describes a more complex glandular organ, placed in the parenchyma, on both sides of the intestine, and opening out on the surface of the body, which, he conjectures, may have an excretory function.

iii. *The Epistome*.—This organ is only present in the freshwater Polyzoa; but its homologue may, I believe, be found in the so-called “buccal shield” of *Rhabdopleura* (see p. 578); and in both of them may be recognized, in my judgment, the equivalent of the molluscan foot†. G. O. Sars has shown that in *Rhabdopleura* the “shield” occupies the same position as the epistome of the *Phylactolæmata*. Both these organs bear the same general relation to the buccal and anal orifices and to the gill-filaments or tentacles as the foot of the more typical mollusk. There seems to be no reason to doubt the homological identity of these structures‡.

iv. *The Pedal Gland*.—This organ occurs only in the genus *Loxosoma*: in some species it is confined to the larva; in others it is permanent in the adult. It is situated at the base of the peduncle, and supplies the secretion by which the animal is attached. It is interesting as being, in all probability, the homologue of the

* Ann. d. Sc. Nat. 6^e sér. Zool. v. (1877), art. no. 3.

† Allman has taken a different view of the homologies of these organs. See his ‘Freshwater Polyzoa,’ p. 46, and paper “On the Relations of *Rhabdopleura*,” Journ. Linn. Soc. Zool. vol. xiv. p. 581.

‡ See Ray Lankester, “Remarks on the Affinities of *Rhabdopleura*,” Quart. Journ. Micr. Sc. xiv. (n. s.) p. 77.

“shell-gland,” detected by Ray Lankester* in many of the Mollusca. The two organs exhibit a very similar structure, and occupy a corresponding position.

Affinities of the Polyzoa.—When we come to inquire into the exact position of the Polyzoa in the Animal Kingdom, we encounter a host of discordant opinions. They have been ranked among the Worms (Leuckart, Gegenbaur, Schneider, Ehlers—the two latter authors placing them near the *Gephyræa*); Barrois, though doubtful, inclines to connect them with the Rotifera; Reichert would approximate them to the Cœlenterates; Milne-Edwards, Agassiz, Allman, Huxley, Ray Lankester, and others either refer them to the Mollusca, or place them in a dependency of this subkingdom, the Molluscoida.

The subject must of necessity be treated briefly here; and I shall confine myself in great measure to a statement of the grounds on which I hold that the Polyzoa are essentially Molluscan. That they exhibit points of resemblance to the Worms may be admitted at once; and whatever view may be taken of them, this can hardly excite surprise. But the question really is, to which group are they united by a participation in its most distinctive characteristics. Now two of the most essential features of the Molluscan organization are certainly the gills and the foot. To take the latter first, we have the equivalent of this important organ amongst the Polyzoa. In one section of the class (*Phylactolæmata*) it occurs universally. I have already pointed out that the epistome, from its position in relation to other parts, may

* See his valuable paper on “the Development of the Pond Snail, and on the Early Stages of other Mollusca,” Quart. Journ. Micr. Sc. xiv. (n. s.) p. 365.

be regarded as the homologue of the foot (Woodcut, fig. xlv., 1, *F*). The organ, indeed, has changed its character and function in correspondence with the change in the conditions of life; but it maintains its original relations to the other elements of structure, and is easily recognizable in its disguise. In *Rhabdopleura* (which is a true Polyzoon) it seems to resume to some extent its primitive office, in the absence of a muscular system, and at the same time exhibits a considerable increase in size. We are not surprised at finding but slight traces of the organ in forms which have taken on a stationary habit of life, nor at its total disappearance in many of them. But the presence of this most distinctive Molluscan structure within the Polyzoan group is a striking indication of its affinities.

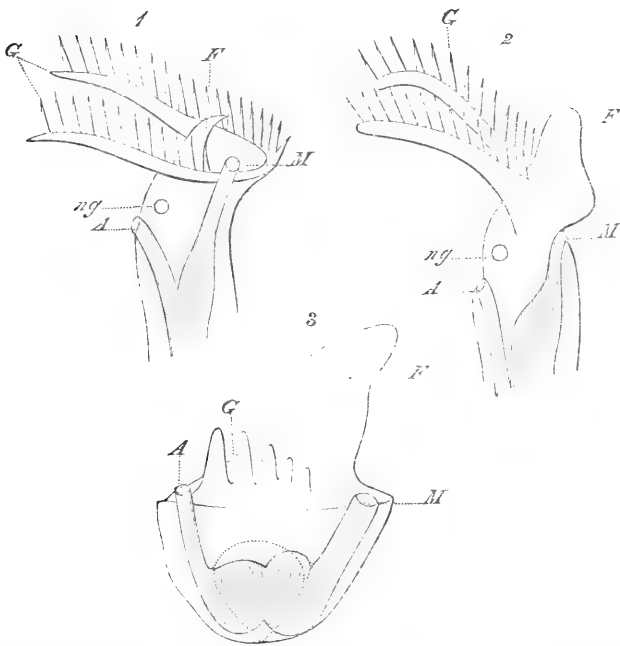
Secondly, as to the gills of the Mollusca, they correspond in all essential particulars with the tentacular corona of the polyzoon. If we compare the latter, as it appears amongst the *Phylactolæmata* or in *Rhabdopleura* (Woodcut, fig. xlv. 1, 2), with the cirriferous appendage of the Brachiopod, we find the closest resemblance between them*, and not a mere resemblance, but such an identity of relation to other portions of structure as clearly indicates their homology. The foot amongst the *Brachiopoda* is very slightly developed; but the disposition of this organ, of the arms, and of the oral and anal openings is the same in them as we find in *Rhabdopleura*. Turning to the other *Acephala*, the arrangement and mutual relation of these parts (as Ray Lankester has insisted) are for the most part identical in the Lamellibranchs

* The mobility of the tentacular plumes of *Rhabdopleura* is a point in which they agree with the arms of the Brachiopod.

(Woodcut, fig. xlv., 3, compared with 1 and 2) and the foot-bearing Polyzoa. In the former the line of gills is interrupted *behind* the foot; and so it is in *Rhabdopleura**. The arm of the latter is also strictly comparable with the gill-plume of the Gasteropod.

The tentacles, then, of the Polyzoa are the homologue of the Molluscan gills; in some of their modifications

Fig. xlv.



1. *Phylactolematous Polyzoon*. 2. *Rhabdopleura*. 3. *Young Cyclas*.
M. Mouth. A. Anus. F. Foot. G. Gill-tentacles. ng. Nerve-ganglion.

* See Ray Lankester, "Notes on Embryology," Quart. Journ. Micr. Sc. xvii. (n. s.) p. 424; "Affinities of *Rhabdopleura*," *ibid.* xiv. (n. s.) p. 77; Huxley, 'Classification of Animals,' *Brachiopoda*: Hancock, "Anatomy of Freshwater Polyzoa," Ann. N. H. 1850.

they exhibit a close parallelism to the branchial organs of the other *Acephala*.

Reference has already been made to the so-called "shell-gland" which occurs so extensively amongst the Mollusca. That the homologue of this characteristic organ may be found in the "foot-gland" or "fixation-gland" of *Loxosoma* there can, I think, be no doubt; and if so, we have here another of the essential features of the Molluscan organization amongst the Polyzoa.

If we take the evidence of embryology on this question, we find a remarkable agreement between the larvæ of the *Brachiopoda* and *Polyzoa**, also between the primitive form of the latter (as demonstrated by Barrois) and that of the Molluscan group (*trochosphere* of Ray Lankester). The "general resemblance" between the larvæ of the *Entoprocta* and the *Rotifera*, on the strength of which Barrois is inclined to believe in an intimate relationship between the Polyzoa and the latter, will hardly weigh against the positive evidence of their Molluscan affinities. The adult forms of the two classes are essentially distinct.

On the grounds thus briefly indicated, which may be summed up in the proposition that the most characteristic organs of the Mollusca have a place amongst the Polyzoa, these two groups, it seems to me, should remain in one and the same subkingdom. I quite agree with Prof. Lankester that the subgroup of the *Molluscoida* is superfluous. The Polyzoa, in spite of adaptive changes, are, like the *Brachiopoda*, to which they are most nearly related, of the true Molluscan race.

* "Les larves de Terebratule et Terebratuline présentent donc réellement une ressemblance étonnante avec la forme primitive des Bryozoaires."

- BARROIS.

DISTRIBUTION IN SPACE AND TIME.

The number of species described in the present work as occurring on the British coasts is 235. Of these, 69 have not so far been found elsewhere; but of course no inference as to their range can be drawn from this negative fact. For 28 species Shetland is the only British locality: of these, 8 have not been found (recent) beyond it; and the remaining species are almost all Arctic forms, which appear to have here their southern limit. Two of the number, however, are exceptions, and range much further south—one (*Cellaria Johnsoni*) being a rather abundant Mediterranean form, and extending to Madeira. In this case Shetland appears to be the northernmost limit in the range of an essentially southern form, the curious point being that so far it has not occurred at any intermediate station between south and north*. Another of them (*Porina borealis*) is common to the deep water of the "Outer Haaf" and the Arctic seas, and to great depths off the coasts of Florida, Portugal, and the Azores. In this case we have to do with one of the "abyssal" forms, which are remarkable for their extended distribution.

The Shetland sea, as Mr. Norman has remarked, seems to be "in an especial manner the meeting-place of northern and southern types." Arctic forms, as we have seen, descend to it, and in many cases go no further south; southern forms have made their way up to it, and generally have not become naturalized in the colder waters beyond it. Out of 68 species recorded in the present

* Norman mentions other cases of a similar kind ("Shetland Dredging Report," Rep. Brit. Assoc. for 1867, p. 248).

work as common to Britain and the Mediterranean, about 40 have occurred in Shetland. Of these, some are species enjoying a very wide range, and a large proportion are generally distributed on the British coasts.

About 24 of the British species are common to the Mediterranean and the Arctic seas: the greater portion of them are probably northern forms which have migrated southwards; and more than half are also inhabitants of the North-American coast.

It is interesting to trace the course of the northern forms in their migrations. Some have moved southward and found their terminus in the Shetland sea; others have extended their range down the north-eastern coasts of Scotland and England*; others, again, have spread themselves to the Hebrides and west coast of Scotland, and to the opposite coast of Antrim, but apparently not further†; some are widely distributed on the English coasts; and a certain number have found their way far south‡.

If we turn now to the southern forms, we find a nearly parallel series of facts. A number of Mediterranean species reach our seas, which do not pass much beyond the south-western district, a few of them ranging for a greater or less distance up the western side of England,

* Such as *Cellularia Peachii*, *Menippea ternata*, and *Scrupocellaria scabra*.

† Such as *Leprelia polita*, *Schizoporella sinuosa*, *Mucronella laqueata*, *Escharoides rosacea*, *Stomatopora compacta*, *S. diastoporides* (also at Wick), *Hornera lichenoides*.

‡ *Cribilina annulata* has migrated from the Arctic seas to our south-western shores (Cornwall), and has also made its way down the north-western side of Scotland (St. Andrews).

Jeffreys gives a list of 76 species of Mollusca, usually considered northern, which are common to the North Sea and the Mediterranean. He adopts Forbes's view, that at some former period "there was an open communication between the Atlantic and the Mediterranean, by which the fauna became diffused."—*Shetland Dredging Report*, 1867.

and a still smaller number in a south-easterly direction (Hastings). These give a peculiar interest and charm to the marine fauna of Devon and Cornwall and the Channel Islands. Amongst them may be named *Mimosella gracilis*, *Lichenopora radiata*, *Diastopora Sarniensis*, *Entalophora clavata*, *Retepora Couchii*, *Lepralia adpressa*, *Lepralia foliacea**, *Schizotheca fissa*, *Smittia cheilostoma*, *Schizoporella Ceciliæ*, *S. sanguinea*, *S. vulgaris*, *S. armata*, *S. venusta*, *Diporula verrucosa*, *Cribrilina Gattyæ*, *C. figularis*, *Microporella violacea*, *Caberea Boryi*.

Other southern forms extend much further north; and a small group occurs in the Shetland seas. A very limited number have found their way to the north-east of Scotland and England; and in similar cases Mr. Norman has shown it to be probable that migration has taken place along the western and northern and down the eastern coasts†.

The north-eastern district is characterized by the prevalence of Arctic and boreal forms, and the absence for the most part of distinctively southern species, even of such as have found their way as far north as Shetland.

Amongst the British Polyzoa we find a number of erratic species having a wide and somewhat anomalous range. For instance, *Cellaria fistulosa* has occurred in the Mediterranean and at Madeira, in South Africa, in Scandinavia and North America, in the Indian Ocean, in Australia and New Zealand. *Microporella ciliata*, another cosmopolitan form, ranges to Florida, California, the Arctic seas, Scandinavia, South Africa, the Arabian sea, Australia, and New Zealand. *M. Malusii* has been found in the Arctic seas, Scandinavia, the Black Sea, the

* *L. foliacea* has occurred in the Hebrides.

† *Bugula turbinata* is probably a southern form which has thus made its way to the Durham and Yorkshire coasts.

Mediterranean, Madeira, South America, Australia, New Zealand. *Caberea Boryi* has a wider range. These are in no measure abyssal forms (which are generally very widely diffused), but flourish between tide-marks and in shallow water, though also found at greater depths. There are many facts in the distributional history of the Polyzoa of which it is difficult to find an adequate explanation. In addition to migration along the coast-lines and through the profound depths, which are subject to uniform climatic conditions, there has been a more irregular and sporadic diffusion by the agency of currents, floating weed, timber, &c., and by means of ships. Probably the latter may have played a not unimportant secondary part in determining some of the more abnormal phenomena of distribution. Many of the species exhibit great adaptability to different climatic conditions, and if transported to distant regions might readily accommodate themselves to their new home.

Glancing at the foreign relations of our native species, we find a very close resemblance between the Polyzoan fauna of the south-west coasts of France and of our own; of 53 species recorded by Fischer 45 or 46 are British. A small group is common to our shores and to those of South Africa: the species composing it are in great measure very widely distributed forms; and almost all of them are also Mediterranean. Of the species (about 30) which are both Madeiran and British, almost all are essentially southern forms: most of them have been recorded as Mediterranean; and probably all will prove to be so. One or two northern intruders (*Scrupocellaria scabra* &c.) occur amongst them. Australia and New Zealand have each a few species that belong to our fauna; and of

these rather less than half are common to the two countries.

About 100 British species occur on the more southern coasts of Norway, and about 70 within the Arctic region; no distinctively southern forms, I believe, are met with amongst them. About 50 of our species range to the North-American coast, almost all of which have been recorded from the Arctic seas*.

It is interesting to compare the number of species found in three well-marked districts (each of which has been thoroughly investigated)—the south-west coast of England, Shetland, and portions of the north-east coast of England †.

	Shetland.	South-west.	Northumberland and Durham.
Cheilostomata . .	102	103	59
Cyclostomata . .	21	17	12
Ctenostomata . .	11	17	16
Pedicellinea . . .	2	2	2
Podostomata . .	1	0	0
	<hr/> 137	<hr/> 139	<hr/> 89

Turning to the distribution of our British species in time, we find that a considerable number of them existed in the Tertiary period. Many are recorded by Busk; and about 40 are included in the list of the Upper Tertiary

* We may expect a flood of light to be thrown on the subject of distribution by the results of the 'Challenger' expedition, when published. In their absence it would hardly be safe to indulge in generalization.

† Alder, 'Catalogue of Zoophytes of Northumberland and Durham' and Supplement. Norman, "Shetland Polyzoa," Rep. Brit. Assoc. 1867. Hineks, "Catalogue of Zoophytes of South Devon and Cornwall." The Shetland and South-west lists have been revised; the North-east is as given by Alder

Polyzoa for which I am indebted to Mr. A. Bell*. To these must be added species detected by Manzoni in the Italian Pliocene, by Waters in that of Sicily, and by Reuss in the Tertiaries of Austria and Hungary. Amongst the latter are a number belonging to the Miocene age. Altogether about 60 of our species have thus far been recorded from the Tertiary beds. Two or three forms seem to be identical with Cretaceous species.

The Polyzoa are of venerable antiquity; they occur in the Palaeozoic rocks, but are chiefly represented there by the *Cyclostomata*† or kindred forms. There is evidence, however (as I learn on the excellent authority of Mr. R. Etheridge, Jun.), of the existence of a few Cheilostomatous genera at least within this epoch; and probably the group is represented in the Silurian division of it. The Polyzoa abound in the Jurassic strata, and seem to reach their maximum in the Chalk. In the latter the *Cyclostomata* exhibit a wonderful variety and beauty; the *Cheilostomata* also have here reached their full development.

CLASSIFICATION.

It is quite unnecessary to enter into the various systems of classification which have long since had their day, and which retain no permanent value.

Johnston‡ recognized the Molluscan affinities of the Polyzoa; and his classification in its leading features

* In the nomenclature adopted by Mr. Bell the *Middle Pliocene* includes the Coralline Crag and part of the Red Crag, and the *Upper Pliocene* such portions of the latter as have a fauna closely assimilated to that of the boreal European Seas. The term *Palaeolithic* is employed to designate post-glacial deposits.

† Of recent genera, *Stomatopora* and *Diastopora* appear to occur in the Silurian rocks.

‡ 'History of British Zoophytes,' 1847.

agrees with the skilfully devised system which we owe to Mr. Busk, and which has obtained so wide a currency*. As an artificial arrangement, which alone it claims to be, the latter leaves little to be desired, and has rendered the most important service in promoting the accurate knowledge of Polyzoan forms. But, from its very nature, however good of its kind, it could only hold a provisional place. Marshalling the known forms in convenient groups distinguished by easily recognizable characters, it is an admirable instrument in the hands of the student for the identification of species; but it gives him no clue to their natural relations. Its families are, for the most part, founded on characters of the slightest significance; and the forms ranked under them have often little to unite them but some trivial peculiarity. Thus the extensive group of the *Escharidæ* is based on the ramose condition of the zoarium (a structural feature of comparatively little moment), and includes a heterogeneous collection of species, many of which have little in common but their branching stem, and are isolated from their nearest of kin; and the same criticism applies to the genera.

D'Orbigny's elaborate classification in his 'Paléontologie'† has one good feature at least: his family groups have a wider range, and embrace diversities in the mode of growth. His genera, on the other hand, are often founded on utterly trivial features, and have been multiplied indefinitely to represent every insignificant variation of habit. As a systematist we owe him little

* British-Museum Catalogue, 3 parts; 'Crag Polyzoa,' Palæontographical Society.

† Pal. française, Terrains Crét., vol. v.

(his nomenclature is uncouth and bewildering) ; but his knowledge of Polyzoan form is perhaps unsurpassed, and by his clear diagnosis and splendid plates he has given us a new revelation of the structural variety and beauty of the class.

We owe to Prof. Smitt* the first serious attempt to substitute a natural system for the purely artificial arrangements hitherto in use ; and it may at least be said that, if he has not overcome all the difficulties incident to the work and has left many problems unsolved, he has given us the most fruitful suggestions, and may perhaps have struck the track along which future advances must be made.

He has aimed at a genealogical classification, starting with the proposition that the variations of species follow the line of their development and may be in great measure explained by it. The Polyzoa, he remarks, as compound animals offer great facilities for the study of the laws and causes of variation. The differentiation of the colony gives us a series of variations, running from the early and simple states to the fully developed form, which is the parallel of the series of differences amongst species. Thus the British species of *Crisia* represent the evolutionary stages of one and the same type, of which Smitt regards *C. geniculata*, Milne-Edwards, as the first and simplest. The forms of this genus he would arrange, according to the law of their evolution, in a series, the members of which, springing from a common origin, will hold each its evolutionary grade.

* "Bryozoa marina in regionibus arcticis et borealibus viventia," *Œfy. Kongl. Vet.-Akad. Förh.* 1867 ; "Kritisk Førteckning," *ibid.* 1864 and following years ; 'Floridan Bryozoa.'

Of the *Cheilostomata* he says :—" *Hoc enim certum dicimus, ut ex origine simili progressæ sint hæ formæ, quarum coloniæ et individua in uno vel altero stadio evolutionem sistere possint;*" and he summarizes his doctrine thus :—" *Si sermone theoretico uti licet, sicut individua, sic etiam species et ceteræ divisiones, quæ systema naturale conficiunt, legibus evolutionis subjactæ sunt.*"

Certainly a most interesting field of inquiry is here opened before us; and though we may not be prepared at present to accept Prof. Smitt's view (and as little are we prepared to reject it), there can be no doubt that it should give for some time the direction to investigation.

It seems to me, however, that the attempt at a genealogical arrangement in detail, if it should ever be feasible, is certainly premature, and that even in the hands of so able and conscientious an observer as Prof. Smitt it yields any thing but a satisfactory result. He himself admits the serious difficulties attendant upon the work, some of which are never likely to disappear*.

It must, I think, be admitted that his reduction of the older species is, to a considerable extent, excessive, whilst, at the same time, the grounds on which forms are associated in one and the same specific group are often questionable, and no small amount of confusion is caused by the blending of species of doubtful affinity under a single name.

Our knowledge of the morphology of the class will be better promoted at the present stage by keeping separate,

* "Iterum et iterum memoranda est ignorantia nostra præcipue specierum extinctarum, quæ limites harum divisionum incertos facit."—*Ezf.* 1867, p. 486.

and clearly discriminating, the more constant and permanent forms, with due attention to their evolutionary history and varietal tendencies, than by merging them in genealogical groups the composition of which must, in many cases, be largely speculative.

One of the most important features of Prof. Smitt's system is the place which he assigns to the *zoæcium* in the construction of families and genera. The mere mode of growth he treats as a perfectly subordinate character, and bases his divisions chiefly on the essential element of the structure, the *cell**. This revolutionary step involves the breaking-up of a large proportion of the older genera and the wide dispersion of forms hitherto most closely associated; but there can be no doubt that it is a necessary preliminary to the introduction of a natural system. The varieties of habit which have been made the criteria of genera, may occur within the limits of a species. It is not the mode in which the cells combine, but the cell itself, that is the true test of relationship and the essential basis of a natural group. Prof. Smitt has remarked, "*Semper videbimus, ubi forma zoæcii eadem sit, ceteras dissimilitudines altero vel altero modo evanescere.*"

Retaining Mr. Busk's three principal divisions of the *Gymnolæmata*, he arranges the *Cheilostomata* under four groups:—the *Flustrina*, with quadrate cells, the front surface of which is flat and equals the area of the primitive aperture; the *Cellularina*, with corneous or corneo-calcareous infundibuliform cells, the inferior portion of which

* Of course, in practice, this principle applies chiefly to the *Cheilostomata*. Amongst the *Cyclostomata* there is great uniformity of structure in the *zoæcium*; and in the case of the *Ctenostomata* other important characters are available.

below the aperture is tubular or obconic; the *Escharina*, with calcareous cells, the aperture of which about equals in size the operculum, no membranous area being left; and the *Celleporina*, with calcareous cells more or less vertical to the plane of the colony, with a terminal aperture, and irregularly heaped together. The families and genera are constructed in harmony with the principles which have been briefly indicated.

It is impossible to estimate too highly the thoroughness of research on which Prof. Smitt's classification rests, and the important contribution which he has made towards a natural system, however much we may be disposed to dissent from some of his results.

In his great work on the Embryology of the Polyzoa*, Barrois contends that in classifying these animals account should be taken of all the forms in the life-series together, and sketches an arrangement suggested by the study of the larvæ (p. 250), for comparison with that of Smitt, from which it differs in some important respects. Our knowledge of the larval forms, however, is as yet too fragmentary to allow of our building much upon it; Barrois's sketch is quite hypothetical, and, though interesting in itself, can only be accepted as a suggestion requiring the confirmation of further research.

In the present work the Polyzoa are ranged under the subclasses instituted by Ray Lankester, and based on the characters of the lophophore. Most of them are Holo-branchiate, and have the tentacles in a continuous series. A single genus only exhibits the Pterobranchiate structure, in which the Molluscan character is more pronounced, and the lophophore is broken into two distinct

* 'Rech. sur l'embryologie des Bryozoaires,' 1877.

arms, bearing a resemblance to the branchial appendages of the Brachiopoda.

The *Holobranchia* form two cardinal groups—the *Ectoprocta*, in which the lophophore surrounds the mouth only; and the *Entoprocta*, in which it incloses both the orifices of the alimentary canal*.

The former division embraces the great body of the Polyzoa; and its marine forms are comprised in a single order, the *Gymnolæmata*, distinguished by two principal features, the complete abortion of the foot and the circular disposition of the tentacles.

The *Gymnolæmata* I have ranged under the three well-known suborders founded by Busk on certain structural peculiarities of the cell.

i. *Cheilostomata*.—These are distinguished by the presence of a movable corneous valve, closing the orifice through which the tentacular corona is protruded; the operculum is furnished with two sets of muscles, by means of which it is opened and shut. In this division we meet with some special structures which are wanting elsewhere: the ova are commonly matured in distinct marsupia; appendicular organs (*avicularia* and *vibracula*), which, as we have seen, are modifications of the Cheilostome cell, are present in great abundance. The calcareous test, in a large proportion of the forms, is highly developed; and there is also considerable variety, and, in

* Barrois has studied the development of the corona in *Acyonidium* (*op. cit.* p. 257, pl. xvi.), and finds that at a certain stage the arrangement of the tentacles is temporarily the same as that which is permanent in the *Entoprocta*; this is followed by a division of the corona into two symmetrical halves, as amongst the *Phylactolæmata*; and this gives place to the typical conformation of the *Ectoprocta*. The developmental history, therefore, gives us the comparative rank of these three divisions, and shows the *Entoprocta* to be the lowest in the scale.

many cases, a good deal of specialization in the structure of the polypide.

ii. *Cyclostomata*.—These, which are the earliest extant forms, are distinguished by the simple, inoperculate orifice of the zoæcium.

Simplicity, indeed, is in the highest degree characteristic of the group: the cells are universally tubular; the polypide is without complexity of structure and has a small number of tentacles; all appendicular organs are wanting. There is also a remarkable uniformity in the embryology; and the larvæ of the leading families are identical. Barrois is right in describing it as “le groupe le plus naturel et le mieux circonscrit de la classe entière des Bryozoaires.”

iii. *Ctenostomata*.—The leading characteristic of this division is the curious opercular mechanism of the cell. The upper portion of the cell-wall is of slighter material than the rest, and terminates above in a number of delicate setæ held together by a thin transparent membrane. (See Woodcut, 35 *ec'* and *op*, p. 562.) When the polypide retreats, the whole of this anterior portion is drawn in by means of a special apparatus of muscles, and the setæ, being brought closely together, form an operculum (or protective covering) above the tentacles. This arrangement secures the freest play for the corona when exerted, and perfect security when the polypide withdraws. The *Ctenostomata* are also characterized by their horny, or membranous, or membrano-gelatinous tests; they are never calcareous. Marsupia and appendicular organs are wanting.

Ehlers has criticised the constitution of this division: he considers that the setose operculum is not suffi-

ently diagnostic, as we find a similar structure in some *Cheilostomata* (e. g. *Aetea*) ; he also objects to the union of the *Halcyonellea* and *Stolonifera* in a single group. As to the latter point, he seems to me to have exaggerated the amount of difference between these two sections. The primitive forms of *Stolonifera*, such as *Victorella*, are very slightly removed from those *Alcyonidia* in which the cells are more or less detached and arranged in linear series. In the former the erect, tubular portion of the adult cell is *a direct continuation of the stolon* ; in the young state this erect portion is wanting, and the cell is wholly decumbent and *in the line of the stolon*. It is essentially the same as a cell of *Alcyonidium disjunctum* or of *Arachnidium*. If the fore part of the latter were to be produced into a tubular extension (and this takes place in some cases, as in *Alcyonidium mamillatum* and *Arachnidium fibrosum*), it would be almost identical with such forms as *Victorella* and *Cylindracium*. In the higher *Stolonifera* (such as *Bowerbankia*) the stolon must be regarded as made up of cells in which the polypide is aborted, and the true zoöcium is the equivalent of the tube of *Victorella*, which has gradually become contracted below and isolated from the stolon. The two groups, then, are closely connected ; and there seem to be no sufficient grounds for separating them.

As to the second objection raised by Ehlers, I confess I cannot see that the existence of certain obscure vestiges of the setose operculum in a few forms occupying the borderland of the Cheilostomatous division should be accounted fatal to the present group. In the "frill" of the genus *Aetea* the structure has entirely lost its original character ; and if this relic should indicate a not distant relationship

between the two sections, it would only be one more proof that in our classifications we may not look for sharply defined provinces, but must be content with the "vanishing lines" of nature.

Our real perplexities commence when we attempt to frame the families and genera; for in the case of the Polyzoa it is extremely difficult to seize the significant characters. This remark applies especially to the *Cheilostomata*. Amongst the Cyclostome forms* there is so much uniformity in the zoœcia, that we are compelled to base our divisions on the grouping or mode of combination. Throughout this suborder the cell has undergone the slightest modification; but there is an almost endless variety in the zoarial form. In dealing with the *Ctenostomata* important characters are supplied by the polypide and the structure of the zoœcium, and we have comparatively little difficulty in defining well-marked groups. But in the case of the *Cheilostomata*, and especially of the Escharine forms (in the classification of Smitt), it is otherwise. Here the polypide gives us no material help, exhibiting few variations of any systematic importance. Amongst the *Aeteidæ* it is of a very simple type, and reminds us of that of the *Crisiidæ*; in this, as in other elements of structure, this group makes an approach to the *Ctenostomata*. In the genus *Bugula* it exhibits strongly marked features; but such differences as generally occur are devoid of any special significance. The *avicularia* are for the most part much too inconstant to serve the purposes of the systematist; and their history shows us that as indications of affinity they are seldom to be

* On the gemmation of the *Cyclostomata*, see Barrois, 'Embryologie,' p. 76.

trusted. There remain the characters of the cell itself and the habit of growth. It can hardly be deemed doubtful which of them should have precedence in a natural system; we may go very much further, indeed, and say that in such a system the latter must hold a very secondary and subordinate place. The essential structure of the cell, as one of the primary zooidal forms, must certainly be accounted the most important point, both in itself and as a clue to relationship. The mere habit is, so to speak, a superinduced condition, which may be different in the most nearly related and similar in the most divergent forms; and groups based on it, instead of fitting in with natural affinities, are found to traverse them at all points. Thus the venerable family of the *Escharidæ* (auctt.) is a mere jumble of incongruous elements, and no more represents the natural relationships of the forms which compose it than would a group of plants founded on the colour of their flowers. In the same way the genus *Lepralia* (auctt.) is a miscellaneous collection, made up, as it were, of numerous distinct nationalities, included within a purely artificial boundary-line. The older systems, indeed, for the most part, inverted the true order, and gave the first place to secondary, but easily recognizable, characters, thus sacrificing nature to convenience.

It is an important fact that within the compass of a single species the most diverse modes of growth may occur. Thus in *Membranipora arctica* (of which I have examined numerous specimens obtained by the Dutch Arctic expedition) we meet with a crustaceous state, in which it creeps as a network over stones, a Hemescharine, in which it rises into unilamellate expansions, and an Escharine, in which it forms well-compacted bilamellate

fronds. Many cases of the same kind occur. *Smittia Landsborovii* and *Lepralia foliacea* exhibit the same diversities of habit, the crustaceous predominating in the former and the foliaceous in the latter. A considerable number of species are now known in which the same cell is associated with very various modes of growth. The genus *Porella* of the present work embraces species which exhibit the most striking differences of habit; but they all possess zoëcia which are both essentially identical in the adult state and pass through the very same course of development. So far as the cell is concerned, there are none but specific distinctions between them; and we cannot doubt that it is more philosophical to unite them in one genus on the strength of their structural similarity, than to separate them for their diverse habit.

I should lay it down, then, that in the formation of families and genera in this division, and especially in the Escharine group, the characters of the cell must be taken as the basis, and a secondary place be assigned to mere zoarial habit.

What, then, are the most significant features of the zoëcium for classificatory purposes? Form, superficial sculpture, the presence or absence of spines or other appendages, these are generally too variable and inconstant to yield any sure criteria. But we may find such in the structural peculiarities of the cell—as, for instance, the modifications of the *aperture*, the degree in which the primitive opening is preserved or obliterated, the ribbed condition of the front wall (as in *Membraniporella* and *Cribrilina*), the chambered condition of the cavity (as in *Steganoporella*), &c. One of the most constant features of the zoëcium, too, is to be found (as noticed long ago

by Hassall) in the orifice, which exhibits a series of well-marked modifications, and has in some cases a developmental history, which affords the most valuable, because the most significant, characters.

In the Escharine* group it seems to me that the families and genera should be based almost wholly on the zoëcial character; but I am certainly not prepared to hold that other structural elements should never be taken into account. The *Flustridæ*, which seem to constitute a most natural group, have a true Membraniporidan cell, and hold their separate place by virtue of their corneous and foliaceous zoaria. It certainly seems desirable that this marked zoarial modification should be distinguished by a separate name. Probably, however, it might be well to include this group and the *Membraniporidæ* in a single family, based on the unity of the cell. In such a tribe as the Polyzoa there must undoubtedly be some flexibility in our system.

The principal systematic changes will be found in the Escharine division, where also the chief difficulties have been encountered. Many of the generic groups (such as *Membraniporella*, *Cribrilina*, *Porina*, *Smittia*, *Lepralia*, *Mucronella*, &c.) will, I think, commend themselves at once to the student. Some are less strongly marked, but not, I believe, less natural. A few have more doubtful claims, and may require revision in the light of fuller research†. In all cases I have taken into account such foreign species as were available in studying our British forms.

* I use this term as defined by Smitt, to include the old *Lepralia*, *Eschara*, and kindred genera.

† In a few cases I have not had a sufficiently large number of specimens to allow of the complete study of the form in its various stages.

Here and there refractory species have been encountered, which it has been difficult to range under any constituted group; they have been associated (provisionally) with the forms with which they seem to have the largest amount of affinity.

A word in conclusion as to the nomenclature. The student will note many changes, and will regret (as I do) the loss of old and familiar names. But the changes, such as they are, have been made, not wantonly, but after careful examination, in obedience to a principle which I believe to be, on the whole, eminently conducive to the interests of science. To the new generation, we must remember, they will bring no regrets, but only the gain of a more uniform and stable system.

For the rest, I shall be well content if this revision of the older classification should be a step towards the realization of a natural system, and a help towards a yet further step in advance.

NAME OF THE CLASS.

With reference to the name of the Class, it seems almost vain to hope for uniformity of practice. The continental zoologists universally (I believe) employ Ehrenberg's designation, *Bryozoa*; the English generally, and some Americans at least, give the preference to J. V. Thompson's name. The point has often been discussed, but with little result. The arguments on each side, however satisfactory to those who use them, do not diminish the amount of disagreement. The contrasted opinions have, indeed, their geographical range, and are subject to very stringent laws of distribution.

It seems necessary, however, to re-state the grounds on

which those who continue to adopt Thompson's name rely, and to justify their departure from what is, it must be admitted, the prevalent usage. If the question were merely one of priority, it might be readily and conclusively settled, and in this case the recognized laws of scientific nomenclature would come in to restrain the license of individual systematists, and enforce a wholesome uniformity. But other elements besides mere *date* are involved; and in these the real difficulty lies.

So far as the mere question of time is concerned, the facts are conclusive in favour of Thompson's claim, as long since shown by Busk (1852)* and Allman (1856)†. The term *Bryozoa* first made its appearance in the 'Symbolæ Physiæ' in 1831‡; but Thompson's 'Researches,' in which he proposed the name *Polyzoa* for the type of structure which he had demonstrated in the polypide of the Ascidian zoophytes §, were published in 1830. We learn from himself that his discovery was made as early as 1820; so that he really anticipated Grant (1827) and Milne-Edwards (1828), though the publication of his results was delayed. That his name was published before Ehrenberg's it is impossible to doubt. Carus, however, urges that it had been previously employed by Lesson (in the 'Voyage de la Coquille') for a genus of Tunicates, and that this fact alone must prevent its adoption ||. But the genus *Polyzoa* of Lesson appears not to have made good its place in molluscan nomenclature; I cannot learn that it is found

* "On the priority of the term Polyzoa for the Ascidian polypes," Ann. N. H. ser 2, x. p. 352.

† 'A Monograph of the Freshwater Polyzoa,' pp. 5, 6.

‡ 'Symbolæ Physiæ; seu icones et descriptiones animalium' &c., 1828-1831.

§ This I take to be what Thompson intended.

|| 'Handbuch der Zoologie,' erster Band, ii. Hälfte, p. 790.

in any recent systematic work. Whether it ever became current at all, I am not aware; but it seems to have lapsed; and it is therefore perfectly allowable to give the term another application.

The most plausible objection to the retention of Thompson's name is founded on his own mode of defining it. He uses *Polyzoa* in the singular number, and describes it as "a new animal discovered as an inhabitant of some zoophytes." It is argued that he evidently employed the name to denote the *polypide* merely, and that to make it a class-designation would be to give it a totally different sense from that which he intended*. This reasoning, it seems to me, proceeds on a complete misapprehension of his meaning. He used the term *Polyzoa* (in opposition to *Hydra*) to denote *a distinct type of structure*, which he had demonstrated, and not as the mere name of the single zooid. This is evident from the following, amongst other passages:—"The *Polyzoa* will probably be found in many dissimilar genera of the zoophytes, and even mixed up with *Hydra* in some; . . . and hence this discovery must be the cause of extensive alterations and dismemberments in the class with which they have hitherto been associated. . . . I shall merely indicate here in a general way the whole of the *Flustraceæ*, in many of which I have clearly ascertained the animals to be *Polyzoæ*;" which is equivalent to saying that they exhibited the new type of structure, and were thus distinct from the *Hydræ*. In a word, *Polyzoa*, as he uses it, is essentially a class-designation, and not the name of a mere structural element.

His *Polyzoæ* were polypes exhibiting a molluscan orga-

* See a paper by Mr. A. W. Waters, Proc. Manchester Lit. & Phil. Soc., Microscop. & Nat. Hist. Section, March 11, 1878; Ann. N. H., Jan. 1880.

nization, as distinguished from the *Hydræ*; that is, they were strictly a CLASS*.

As to the form of the word, it seems to me to be a point of the very smallest moment. No doubt *Polyzoæ* would be the proper reading, if we must of necessity accept Thompson's original error in the construction of the word†. But it is surely allowable to alter the ending, and so bring the term into harmony with our present usage. In doing so we retain all that is essential, and we leave the honour with him to whom it is justly due.

Bronn's criticism that the term *Polyzoa* is not distinctive, and may properly be used of other groups besides the present, has a certain weight; but if we were to employ the principle which it implies as a practical test of our nomenclature, it would involve not the mere displacement of a single name, but widespread change and confusion.

Thompson's name, then, seems to me to have every claim to adoption; and as uniformity in scientific nomenclature is clearly desirable, I shall still venture to hope that continental zoologists may not be unwilling to reconsider the

* The following passages may be added, as showing clearly the sense in which Thompson used the term *Polyzoa*:—"The other species of *Sertularia* in which the animals have been determined to be *Polyzoæ* may, . . . perhaps, be referred to *one* genus." "The present Memoir has for its object to demonstrate another form of animal not hitherto known, and which, while it must be allowed to belong to a new type of Mollusca *Acephala*, resembles exteriorly in some manner the *Hydra*; this animal has been designated by the name of *Polyzoa*." In this passage both *Hydra* and *Polyzoa* are used to denote *types of structure*, and not *elements of the compound organism*.

In the prospectus of the whole work, we find the following as the subject of the 10th Memoir:—"Animals of some *Cellariæ*, *Tubuliporæ*, and *Flustracæ* proved to be *Polyzoæ*." To substitute *polypides* for *polyzoæ* in this sentence would be to render it perfectly unmeaning.

† Thompson himself *once* uses *Polyzoa* as the plural form. Mem. 5, p. 96.

grounds on which they have hitherto given their adhesion to Ehrenberg.

NOTE ON THE PHOSPHORESCENCE OF THE POLYZOA.

Phosphorescence has been observed in several species. In *Membranipora membranacea* Dr. Landsborough describes the light as being very beautiful; when a specimen was shaken, it presented the appearance of a "sheet of fire." In *Membranipora pilosa* every cell showed a brilliant little star; the zoarium was like "an illuminated city." *Scrupocellaria reptans* and *Valkeria uva*, form *cuscuta*, are also phosphorescent species. We learn from M. Vélain * that a *Bugula* occurs in the island of St. Paul, in small submarine grottos, which is of a deep azure-blue colour and strikingly phosphorescent. When the water containing it was agitated it showed the most brilliant coloured lights, which changed with astonishing rapidity from red to green, or to azure-blue. When the water was left quiet the beautiful display ceased.

SYSTEMATIC TABLE.

Subkingdom MOLLUSCA.

Branch ACEPHALA.

Class POLYZOA, J. V. Thompson.

BRYOZOA, Ehrenberg, &c.

CILIOBRACHIATA, Farre.

TENTACULIBRANCHIA, E. Ray Lankester.

Acephala with well-developed, separate, ciliated gill-

* "La Faune des Iles St. Paul et Amsterdam," Arch. Zool. expérimentale, 1877.

filaments in the position of oral tentacles; mouth and anus approximate; foot rudimentary or aborted; mantle-skirt absent; inclosed in a chitinous or calcareous or gelatinous cell (=mantle shell); usually forming colonies by continuous gemmation, rarely single.

Subclass HOLOBRANCHIA, E. Ray Lankester.

Lophophore either circular or horseshoe-shaped, bearing an unbroken series of tentacles.

Group *a*. ECTOPROCTA, Nitsche.

Anal orifice without the lophophore.

Order GYMNOLÆMATA, Allman.

INFUNDIBULATA, Gervais.

STELMATOPODA, Van der Hoeven.

Polypide destitute of an epistome (foot); lophophore circular.

Suborder I.—CHEILOSTOMATA, Busk.

CELLEPORINA, Ehrenberg.

Orifice of the zoæcium closed by a movable opercular valve. Ova usually matured in external marsupia. Appendicular organs (avicularia and vibracula) frequently present.

Family I.—Aeteidæ.*

AETEA, Lamouroux.

* The *Aeteidae* with the genus *Beania* are ranked by Carus as a suborder, the *Stolonata*, which is thus characterized —“The conical or tubular cells ranged singly on a tubular stolon.” But *Beania* and *Aetea* are not closely related; the peduncles by which the cells are united in the former are by no means homologous with the creeping stems of the latter, whilst

Family II.—*Eucratiidæ*.

EUCRATEA, Lamouroux.	HUXLEYA, Dyster.
GEMELLARIA, Savigny.	BRETTIA, Dyster.
SCRUPARIA, Hincks.	

Family III.—*Cellulariidæ*.

CELLULARIA, Pallas.	SCRUPOCELLARIA, Van
MENIPEA, Lamouroux.	Beneden.
	CABEREA, Lamouroux.

Family IV.—*Bicellariidæ*.

BICELLARIA, Blainville.	BEANIA, Johnston.
BUGULA, Oken.	

Family V.—*Notamiidæ* *.

NOTAMIA, Fleming.

Family VI.—*Cellariidæ*.

CELLARIA, Lamouroux (part).

Family VII.—*Flustridæ*.

FLUSTRA, Linnæus.

Family VIII.—*Membraniporidæ*.

MEMBRANIPORA, Blainville†.	MEGAPORA, Hincks.
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the cells themselves are of a very different type in the two genera. The *Aeteidæ* seem to be properly ranked as a family of the present suborder; their stoloniferous character is not sufficient to raise them to the rank of a higher group. Amongst the *Eucratiidæ* it is shared by the genus *Eucratea*, but would certainly not warrant its separation from the forms with which in other respects it is most closely allied.

* Families 1 to 5 inclusive constitute the *Cellularina* of Smitt; families 6-9, the *Flustrina*; families 10-14, the *Escharina*; family 15, the *Celleporina*. The last group he has now abandoned.

† *Membranipora pilosa*. The systematic position of this species must be considered doubtful. Its extraordinary larva (Plato LXXXIII. fig. 9) allies it to *Flustrella* and (in some degree) to *Eucratæa*. We are not in a position as yet to determine its affinities with precision.

Family IX.—**Microporidæ.**

MICROPORA, Gray.	SETOSELLA, Hincks.
STEGANOPORELLA, Smitt.	

Family X.—**Cribrilinidæ.**

CRIBRILINA, Gray.	MEMBRANIPORELLA, Smitt (part).
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Family XI.—**Microporellidæ.**

MICROPORELLA, Hincks.	CHORIZOPORA, Hincks.
DIPORULA, Hincks.	

Family XII.—**Porinidæ, D'Orbigny (part).**

PORINA, D'Orbigny.	LAGENIPORA, Hincks.
ANARTHROPORA, Smitt (part).	CELLEPORELLA, Gray.

Family XIII.—**Myrizoidæ.**

SCHIZOPORELLA, .	RHYNCHOPORA†, Hincks.
Hincks *.	SCHIZOTHECA, Hincks.
MASTIGOPHORA, Hincks.	HIPPOTHOA, Lamouroux.

Family XIV.—**Escharidæ.**

LEPRALIA, Johnston (part).	SMITTIA, Hincks.
UMBONULA, Hincks ‡.	PHYLACTELLA, Hincks.
PORELLA, Gray.	MUCRONELLA, Hincks.
ESCHAROIDES, Smitt.	PALMICELLARIA, Alder.
	RETEPORA, Imperato.

* *Schizoporella hyalina*. Barrois notes a peculiarity in the gemmation of this species. The buds originate laterally, instead of at the summit of a cell; and the zoecia may therefore be described as intercalary in their arrangement. (See Plate XLV. fig. 3.) There are also distinctive points in the larva. *Microporella impressa*, it seems, agrees with it in these respects; and Barrois would unite these species in a distinct genus—a course to which I cannot assent, as the differences between the adult forms seem to me much weightier and more significant than the alleged points of agreement.

† This genus is wrongly placed amongst the *Escharidæ* in the body of the work (p. 385).

‡ In the descriptive portion of the text this genus stands as *Umbonella* (p. 316); but since it was in type I have ascertained that a group of

Family XV.—**Celleporidæ.**

CELLEPORA, Fabricius (part).

Suborder II.—**CYCLOSTOMATA**, Busk.

Zoëcia tubular, with a plain inoperculate orifice.
Marsupia and appendicular organs wanting.

Group i.—**RADICELLATA**, D'Orbigny.Family I.—**Crisiidæ.**

CRISIA, Lamouroux (part).

Group ii.—**INCRUSTATA**, D'Orbigny.Family II.—**Tubuliporidæ.**

STOMATOPORA, Bronn.

TUBULIPORA, Lamarck.

IDMONEA, Lamouroux.

ENTALOPHORA, Lamou-
roux.

DIASTOPORA, Lamx. (pt.).

Family III.—**Horneridæ.**

HORNERA, Lamouroux.

Family IV.—**Lichenoporidæ.**

LICHENOPORA, DeFrance. | DOMOPORA, D'Orbigny.

Suborder III.—**CTENOSTOMATA**, Busk.

Orifice of the zoëcium closed by an operculum of setæ.
Zoarium never calcareous. Marsupia wanting.

Group i.—**HALCYONELLEA**, Ehrenberg.Family I.—**Alcyonidiidæ.**

ALCYONIDIUM, Lamouroux.

Mollusca was so called by Arthur Adams in 1863, and Mr. Ridley (of the British Museum), to whose kind assistance I am much indebted, informs me that the name still holds its place in molluscan nomenclature. I have therefore adopted the form *Umbonula*.

INTRODUCTION.

Family II.—**Arachnidiidæ.**

ARACHNIDIUM, Hincks.

Family III.—**Flustrellidæ.**

FLUSTRELLA, Gray.

Group ii.—*STOLONIFERA*, Ehlers.

a. ORTHONEMIDA, Hincks.

Family IV.—**Vesiculariidæ.**

VESICULARIA, J. V.

Thompson.

AMATHIA, Lamouroux.

BOWERBANKIA, Farre.

AVENELLA, Dalyell.

FARRELLA, Ehrenberg.

Family V.—**Buskiidæ.**

BUSKIA, Alder.

Family VI.—**Cylindræciidæ.**

CYLINDRÆCIUM, Hincks.

ANGUINELLA, Van Beneden.

Family VII.—**Triticellidæ.**

TRITICELLA, Dalyell.

HIPPURARIA, Busk.

b. CAMPYLONEMIDA, Hincks.

Family VIII.—**Valkeriidæ.**

VALKERIA, Fleming (part).

Family IX.—**Mimosellidæ.**

MIMOSELLA, Hincks.

Family X.—**Victorellidæ.**

VICTORELLA, W. Saville Kent.

Subclass HOLOBRANCHIA,

Group *b*.—ENTOPROCTA, Nitsche.

Both the orifices of the alimentary canal within the lophophore.

Order **PEDICELLINEA**.

Only order.

Family I.—Pedicellinidæ.

PEDICELLINA, Sars.

Family II.—Loxosomidæ.

LOXOSOMA, Keferstein.

Subclass PTEROBRANCHIA, Ray Lankester.

ASPIDOPHORA, Allman.

Lophophore produced on each side into a process (plume), on which alone the tentacles are developed, forming discontinuous series.

Order **PODOSTOMATA**, Ray Lankester.

Foot large, overhanging the mouth.

Family Rhabdopleuridæ.

RHABDOPLEURA, Allman.

PLATE LXXXI.

FIG.

1. PEDICELLINA CERNUA, var. GLABRA, p. 565.
2. — — —, elongated form.
3. — — —, showing the tentacles folded in.
- 4-6. PEDICELLINA GRACILIS, p. 570.
- 7, 8. LOXOSOMA SINGULARE, p. 573.
- 9-11. LOXOSOMA CLAVIFORME, p. 575.
12. Fragment of the skin of *Hermione*, with individuals of the last species *in situ*, nat. size.

BRITISH

MARINE POLYZOA.

Class POLYZOA, J. V. Thompson.

Subclass HOLOBRANCHIA, E. Ray Lankester.

Group *a*. *ECTOPROCTA*, Nitsche.

Order GYMNOLÆMATA, Allman.

POLYPIARIA INFUNDIBULATA, Gervais, Ann. des Sc. Nat. 1837.

POLYZOA INFUNDIBULATA, Busk, B. M. Cat.

Suborder I.—**CHEILOSTOMATA**, Busk.

Family I.—**Aeteidæ**.

ZOÆCIA tubular, with a lateral membranous area; orifice terminal. Tentacular sheath terminating above in a circle of setæ, which are everted during the expansion of the polypide.

THE *Aeteidæ* exhibit many points of affinity with the Ctenostomata. The more or less erect, cylindrical cell, with the orifice at the top, and the frill-like termination of the tentacular sheath, which must be regarded as the homologue of the setose operculum, are characters which,

as Prof. Smitt has already remarked*, connect these Cheilostomatous forms with the last-named division. To these, others may be added. The production of cells by gemmation from a stolon is characteristic of the largest section of the Ctenostomata as well as of the present family. Another link between it and certain genera amongst the Ctenostomata is the membranous area occupying, in the more typical species, a considerable portion of one side of the zoëcium, which has its equivalent in the genera *Triticella* (Dalyell) and (probably) *Hippuraria* (Busk) and (according to observations which I have recorded in another part of this work) in *Mimosella*.

The *Aeteidæ* constitute a peculiar group; and I agree with Smitt in ranking them as a family, distinguished by the Ctenostomatous cast of its structure.

On the other hand, it must be noted that they are allied to *Eucratea* through the character of the polypide, and in some other points.

The family contains a single genus.

Genus AETEA, *Lamouroux*†.

AETEA, Lamx. Bull. Soc. Philom. 1812: Busk: Smitt, &c.

ANGUINARIA, Lamk. Extrait du Cours de Zool. 1812 (without character): Johnston, &c.

* 'Om Hafs Bryozoernes Uttvekl.' &c., 1865, p. 11; "Kritisk Förteckning öfver Skandinav. Haf-Bryozoer," Öfversigt af K. Vetensk.-Akad. Förhandlingar, 1867, pp. 293-5.

† *Aetea* is clearly a mistake for *Actea* (or *Actæa*), one of the Nereids, according to Homer and Hesiod. Lamouroux himself tells us that his genus was named after one of the daughters of Nereus; but *Actea* is not of their number. Through a blunder of the author or printer this name has been substituted for *Actea*. It occurs in Lamouroux's paper in the Bull. Soc. Phil. (1812), in his 'Hist. Pol. Corall. flex.,' and in his 'Exposition Méthodique,' and has passed into very general use. Nothing could be

FALCARIA β , Oken, Lehrb. Naturg. Zool., Abth. ii, 91, 1815.

CERCARIPORA (for *Aetea truncata* &c.), Fischer, Arch. Mus. Hist. Nat. ii. 292-313.

GENERIC CHARACTER. — ZOECIA *calcareous, tubular, erect, with a membranous area on one side; distributed along a more or less adherent, creeping fibre, dilated at intervals; orifice terminal.* OECIA *none.*

THE polypide in this genus is of the simplest type. There is no gizzard; the long œsophagus leads at once into the digestive sac, which is but slightly dilated, and tapers off below; the number of tentacles is small. During retraction the polypide is not folded upon itself, but stretches straight downwards within its cell.

The structure recalls in many respects that of the simpler Ctenostomata, such as *Valkeria*.

Seven species of *Aetea* have been described, of which three occur on our coasts. The genus has representatives in South America (Patagonia), West Indies*, Australia, and Africa, as well as in Europe, where it reaches far north. *A. anguina* ranges from Norway to Zanzibar, and is equally at home in Australia and in our own seas.

The specific distinctions are founded on differences in the size and shape of the cell, and especially in the shape of the oral extremity, in the comparative length of the membranous area, and in the characters of the surface.

We may perhaps regard the straight forms (in which the

gained by the restoration of her lost honours to *Aetea* to compensate for the confusion that would be caused by the displacement of a well-established term. I therefore retain the name as it stands in Lamouroux's works, and as it is known to science.

* D'Orbigny records the occurrence of a species in Cuba, which he names *A. Americana*; but his description is so meagre that it is impossible to decide whether it is really distinct. It is said to be nearly allied to *A. anguina*, but to have the cells very much smaller, and narrower at the extremity..

area occupies a considerable proportion of the length of the cell) as the most primitive, and those in which the upper extremity is modified (as in *A. anguina* and the Australian *A. dilatata*) as the younger in the series.

AETEA ANGUINA, Linnæus.

Plate I. figs. 4, 5.

SNAKE CORALLINE, *Ellis*, Corall. 43. no. 11, pl. xxii. figs. c, C, D.

SERTULARIA ANGUINA, *Linn.* Syst. (ed. 10) 816, (ed. 12) 1317.

CELLULARIA ANGUINA, *Pall.* Elench. 78: *Ellis*, Phil. Trans. lvii. 434, pl. xix. fig. 10 (in paper on *Actinia sociata*).

CELLARIA ANGUINA, *Ell. & Sol.* Zooph. 26.

AETEA ANGUINA, *Lamx.* Bull. Soc. Phil. 1812; Pol. Corall. flex. 153, pl. iii. fig. 6: *Busk*, B.M. Cat. i. 31, pl. xv. fig. 1: *Smitt*, Kritisk Förteckn. iii., Öfvers. Vetensk.-Akad. Förhandl. 1867, No. 5, 280 & 296, pl. xvi. figs. 2-4.

FALCARIA ANGUINA, *Oken*, Lehrb. Naturg. Abth. ii. 91.

SERTULARIA MOLLIS, *D. Chiaje*, An. s. Vert. Nap. iv. 147.

ANGUINARIA ANGUINA, *Flem.* B. A. 542: *Lister*, Phil. Trans. 1834, 385, pl. xii. fig. 4.

ANGUINARIA SPATULATA, *Lamk.* An. s. Vert. (ed. 2) ii. 196: *Johnston*, B. Z. (ed. 2) 290, pl. i. figs. 7, 8: *Busk*, Trans. Micr. Soc. for 1849, 123, pl. xxvi.: *Gosse*, Dev. Coast, 141.

Zoæcia white and glossy, more or less bent, spatulate at the upper extremity, ringed, with the exception of the clavate portion at the top, which is minutely punctate; area occupying from about a quarter to a third of the length of the cell; creeping fibre sinuous, punctulate, swelling out at intervals; a cell originating from each enlargement.

RANGE OF VARIATION. The chief variation seems to be in the length of the spatulate extremity, and of the curved anterior portion of the cell. The enlarged spoon-like head is sometimes elongate, sometimes short and regularly oval in form. There are also differences in the degree in which the upper extremity of the cell is bent and the point at which the curvature commences. But I have not

noticed any approach to the erect mode of growth which characterizes the following species.

HABITAT. On the smaller Algæ chiefly, and especially the red kinds, occasionally on shells, stones, &c., in tide-pools and in the Laminarian region*.

LOCALITIES. Very abundant in the south and west, less common apparently in the north of England, rare in Shetland. Coast of Ireland; Isle of Wight (W. T.): Ayrshire (Landsborough): south coast of Durham occasionally (J. Hogg): Shetland (C. W. P.): Ramsay, Isle of Man; Filey, Yorkshire; Llandudno; Swanage; Ilfracombe; South Devon, most abundant; Guernsey (T. H.): Cornwall (Couch): &c.

GEOGRAPHICAL DISTRIBUTION. Bahusia; Southern Norway (Smitt): Atlantic Ocean; Antarctic Ocean; Tasmania (Busk): Adriatic (Olivi): Biarritz (W. T.): Zanzibar; Natal (W. Oates): Glenelg (T. H.).

Ellis's quaint account of this interesting form is worth reproducing:—"From very small holes in the broadest part of this irregular winding tube [which he had just described] there arise here and there small testaceous white hollow figures, exactly resembling a snake without the lower jaw, in the place whereof is the entrance into the cell." His figure is admirable, and leaves little room for improvement to those who come after him.

The area in this species occupies the underside of the curved portion of the cell; and at the top of it is the mouth; the opercular valve falls, like a little trap-door, when the polypide is about to issue from its cell, and is drawn up and tightly closed after it when it retreats. The tube below

* "Invests those Algæ chiefly whose stems are clothed with hair-like fibres, as *Dasya coccinea*, *Griffithsia equisetifolia*, and *Sphacellaria scoparia*; but found occasionally on smooth-stemmed species, as *Plocamium coccineum*."
—W. THOMPSON.

the spatulate extremity is beautifully ringed. Mr. Busk has noticed the pouch "like the bag of the pelican's beak," which is formed by the membranous covering of the aperture, and remarks that numbers of *Naviculæ* and Infusoria are often found in it. The polypide, which is small and delicate, has usually twelve tentacles of moderate length. When the oral valve opens, a membranous sheath is first pushed out, with a number of setiform processes round its free extremity, which are thrown back and form a kind of frill; and then the polypide instantly darts forth: little more than the pharynx and tentacular crown is protruded.

The swellings on the creeping base in this species are of moderate size, and generally occur at short intervals; so that the cells are set pretty closely together.

Aetea anguina is developed in extraordinary profusion; and bunches of weed are often so thickly covered with it as to appear powdered over with white. Masses of Algæ from Australia are invested in a similar way by the kindred *A. dilatata*.

AETEA RECTA, Hincks.

Plate I. figs. 6, 7.

HIPPOTHOA SICA, *Couch*, Corn. Faun. 102, pl. xix. fig. 9: *Johnston*, B. Z. ed. 2, 292.

AETEA RECTA, *Hincks*, Devon Cat., Ann. N. H. ser. 3, ix. 25, pl. vii. fig. 3.

STOMATOPORA GALLICA, *D'Orbigny*, Pal. Franç. Terr. Crét. v. 836, pl. 759, figs. 1-3.

AETEA SICA, *Norman*, Quart. Journ. Micr. Sc. n. s. viii. 216.

AETEA ANGUINA β , FORMA RECTA, *Smitt*, Öfvers. K. Vet.-Akad. Förhandl. 1867, No. 5, 281 & 297, pl. xvi. figs. 5, 6.

Zoæcia tall, nearly straight, very slightly dilated above, truncate at the extremity; surface coarsely ringed below, the upper portion punctulate; area elongate, occupying more than a third of the length of the cell;

swellings on the creeping stem fusiform, finely wrinkled transversely, generally not distant.

HABITAT. On shells, stones, &c., from moderate depths to deep water (80 fathoms).

LOCALITIES. Torbay, abundant; Salcombe; off the Deadman, 60 fathoms; Isle of Man; Lamash, Arran (T. H.): Guernsey; Antrim; Shetland, 40-80 fathoms, frequent; the Minch (A. M. N.): Birterbuy Bay (G. S. Brady).

GEOGRAPHICAL DISTRIBUTION. Bahusia; Southern Norway (Smitt).

In this species the delicate creeping fibre swells out at short intervals into elongate subfusiform bodies, which closely resemble the cells of *Hippothoa*; a zoecium rises from each of them, placed at the larger end. Opposite branches are given off from the sides of these cell-like expansions. The zoecia are at once distinguishable from those of *Aetea anguina* by their larger size and stouter habit, their erect growth, the absence of the spatulate head, and the greater length of the area in proportion to that of the cell. The creeping fibre is also more delicate, and the swellings in its course larger and more regular in form, and finely striated transversely.

I have met with no varieties intermediate between these two very distinct forms.

The oral portion of the cells is very apt to be broken off; and when this is the case the species resembles an *Hippothoa* with a produced tubular orifice (Plate I. fig. 7)*.

* Though I have no doubt that Couch founded his *Hippothoa sica* on maimed and imperfect specimens of the present form, his name has, in my judgment, no claim to adoption. He had only seen the creeping base with *portions* of the cells attached to it; and his description, therefore, gives no idea whatever of the real character of the species. He knew nothing of its true cells, and so mistook it for an *Hippothoa* with a tubular mouth. As no student could identify *Aetea recta* by means of the diagnosis which he has given us, as indeed its most essential feature is not included in that

AETEA TRUNCATA, Landsborough.

Plate I. figs. 8-11; Plate II. fig. 3.

ANGUINARIA TRUNCATA, *Landsb.* Pop. Hist. Brit. Zooph. 288, pl. xvi. figs. 57, 57*.

? SALPINGIA HASSALLII, *Coppin*, Ann. N. H. ser. 2, ii. 273, pl. x. fig. 3.

AETEA TRUNCATA, *Busk*, B.M. Cat. i. 31: *Hincks*, Devon Cat., Ann. N. H. ser. 3, ix. 24: *Smitt*, "Om Hafs-bryozoernes Uttvekl.," Æfv. K. Vet.-Akad. Förhandl. 1865, 11, pl. ii. figs. 5-14, and pl. iii. figs. 1-8; *id.* Krit. Fört., Æfv. &c. 1867, 279 & 295, pl. xvi. fig. 1.

? ÆTEOPSIS ELONGATA, *Boeck*, Förh. Vid. Sels. Christiania, 1861, 49.

Zoëcia short, straight, narrowed below, upper extremity truncate; surface minutely punctate; a tubular appendage frequently given off from the middle of the dorsal surface; swellings on the creeping fibre very slender, clavate, generally distant.

Sometimes the cells, instead of being simple, are linked together in a single series, forming erect shoots, all the cells in the series, except the primary one, being supported on long and slender pedicles.

RANGE OF VARIATION. The zoëcia differ much in size; and a dwarf variety occurs, in which they are only about half as large as the ordinary cell. The dorsal appendage, which is in fact a rudimentary cell-pedicle, is sometimes wanting. The habit is either simple, or a number of zoëcia are united in a single series, as in *Eucratea*. The creeping stem is adnate or very loosely adherent.

diagnosis, the case, it seems to me, does not come within the scope of the "law of priority." There is no such species as *Hippothoa sica*; and the name simply lapses.

It is hardly necessary to add that *sica* would be a most inappropriate designation for the perfect *Aetea recta*, however well it may have fitted the portion of it for which it was originally intended.

D'Orbigny has repeated Couch's mistake, and founded his *Stomatopora* (= *Alecto*) *Gallica* on specimens of the present species from which the upper portion of the cells had entirely disappeared.

HABITAT. On Algæ and shells, between tide-marks and in moderate depths.

LOCALITIES. Lamlash Bay, Arran, on *Laminaria saccharina* (Landsb.): Isle of Man, on oyster-shells, common; Ilfracombe, on weed between tide-marks; Swanage; South Devon, not very common (T. H.): Guernsey (Miss Renouf), &c.

GEOGRAPHICAL DISTRIBUTION. Bahusia; Southern Norway (Smitt); Madeira (J. Y. J.).

Aetea truncata presents very different appearances in different states or stages of growth. In its simplest condition, the zoarium consists of lines of sessile cells, distributed at intervals along a delicate thread-like fibre, as in the other species of this genus. It exhibits indeed one peculiarity: a large proportion of the cells are often furnished with a tubular tail-like appendage, given off from the back and usually directed upwards; it varies in length, and originates about half-way down the cell. And in some cases this dorsal tube becomes much elongated, and supports a second cell. From this second cell a slender stem or pedicle is given off, which terminates in a third cell, and so on. The species has taken on the habit of *Eucratea* (Plate II. fig. 3).

This erect and composite form, however, seems to be comparatively rare; more commonly, so far as I have seen, the simple habit prevails. The cells are usually sessile, but occasionally are borne on a short tubular process given off from the creeping stem. They are of a pure white colour, and very bright and glossy. The fibre is of extreme delicacy, and is very minutely but very beautifully dotted over; the enlargements from which the cells rise are slender and comparatively inconspicuous. From each side of them branches are given off nearly at right

angles* ; and not unfrequently these are not adherent, but project as slender tubular processes. The fibre generally is very loosely adherent, except on smooth flat surfaces, where it is more closely adnate.

There is very commonly a constriction just below the aperture of the cell ; and at this point it is often broken across.

Family II.—Eucratiidæ.

Zoëcia uniserial, or in two series placed back to back, expanding from the base upwards, with a terminal or subterminal and usually oblique aperture. Avicularian and vibracular appendages wanting. Zoaria forming slender, branching, phytoid tufts.

THIS family group includes a number of forms of very simple structure and habit. The plan of the zoarium exhibits no complexity and a very small amount of variability within its limits. The cells in a large proportion of cases are linked together in single series, each rising from the upper portion of the one below it. The erect shoots thus formed give off branches ; and the pattern of the ramification varies in the different genera. In the genus *Gemellaria* we have a slight deviation from the perfect simplicity of habit which is so characteristic of this family. The *Eucratea*-like cells are here disposed in a double series, and adhere to one another by the dorsal surface, so that the apertures of the two rows look in opposite direc-

* I have seen a luxuriantly developed specimen on weed, in which these lateral branches were present in profusion, attaining a considerable length and bearing lines of cells. They were slender and of uniform thickness throughout, and showed no trace of the usual enlargements.

tions. In *Scruparia clavata*, Hincks, we have an intermediate form, which connects the uniserial and biserial genera, and illustrates the way in which the one plan of growth may have passed into the other.

Throughout this family, so far as its British representatives are concerned, the zoarium is continuous or not divided into segments by corneous joints.

In defining the genera I have relied chiefly upon the characters supplied by the differences in the aperture and the mode of branching. If the number should seem to be large for so small a group, I can only urge that it is not more than sufficient to represent important modifications of the family type.

The family *Eucratiidæ* includes the whole of the *Gemellariidæ* of Busk, with the exception of the anomalous genus *Notamia* and *Didymia* (which last is distinguished by a very different type of cell). The Australian genus *Dimetopia* is allied to our own *Gemellaria*, and exhibits an interesting modification of the back-to-back arrangement of the cells.

Genus EUCRATEA, *Lamouroux*.

Der. From *Eucrate*, one of the Nereids.

EUCRATEA, Lamx. Bull. Soc. Philom. 1812: Johnston: Smitt.

SCRUPARIA, Oken, Lehrb. Naturg. Abth. ii. 90, 1813: Busk.

SERTULARIA (part.), Linnæus.

CELLULARIA (part.), Pallas.

CELLARIA (part.), Ellis and Solander.

UNICELLARIA (part.), De Blainv. Dict. Sc. Nat. 1830.

CATENARIA (part.), D'Orbigny, Pal. Franç. 1850.

GENERIC CHARACTER.—ZOARIUM composed of a creeping adherent base and erect branching shoots. ZOÆCIA subcalcareous, rising immediately one from the other, so as to form a single series; aperture large, oblique, lateral or sub-

terminal, the oral opening at the top of it ; branches given off from the front of a cell below the aperture. OECIA terminal.

AVICULARIA and VIBRACULA wanting.

TENTACULAR SHEATH *terminating above in a ring of setæ.*

THOUGH agreeing with *Aetea* in the character of the polypide and the general plan of growth, the present genus exhibits a very distinct type of cell. The composite habit, which is rarely met with in the former (having only been noticed in *A. truncata*) is the rule in *Eucratea*, which also branches freely, and forms bushy plant-like tufts.

The structure of the primary cell presents some interesting peculiarities. Each colony of *Eucratea* commences with a small zoecium, which is free (not adherent) and borne on a short stalk, with a single joint in the middle of it (Plate II. figs. 5-8). This stalk, however, does not occupy the position of the usual peduncular portion of the cell, but springs from the front surface, a little below the aperture or area. It corresponds, in fact, with the pedicle of a branch. The primary zoecium terminates below in a short blunt process, which is perfectly free and unattached. The produced peduncular portion, extending in the normal cell from the aperture downwards, is not developed. The aperture occupies nearly the whole length of the cell ; it narrows off to a point below, and expands slightly upwards, being open at the top. The upper extremity of the cell is subtruncate. From the base of the stalk supporting this primary cell, in the specimens which I have examined, another cell, decumbent and adnate, is given off, which exhibits the normal shape, and is attached to the parent zoecium by its lower extremity (Plate II. fig. 7). It may be noticed in passing that there is a striking resemblance between the primary cell of *Eucratea* and the cell of *Beania* in an early stage of

growth. The two are essentially identical in structure.

The creeping base exhibits some curious modifications in this genus. When it is developed on the stems of the more slender Algæ, it consists universally, so far as I have seen, of lines of decumbent cells, from which the erect shoots rise, originating, like the ordinary branches, a little below the aperture. But in other cases I have found it assuming the form of a delicate tubular fibre, like that of *Aetea*, which at intervals swells out into small clavate enlargements, from which the cells arise. I have never seen the passage of one of these conditions into the other; but it is difficult to avoid the conclusion that they are morphologically equivalent, and that the clavate enlargements are merely aborted cells. They are frequently much attenuated in *Eucratea*, sometimes almost obliterated; and in such cases we have an indication of the way in which the chain of adnate cells passes into the perfectly simple tube. Under *E. chelata* I have described a curious variety, in which the decumbent condition of the zoarium appears to be permanent.

Two species of *Eucratea*, as now defined, have been described. One of them, *E. ambigua*, D'Orb., which closely resembles the present form, is a native of South America. *E. chelata* has a wide distribution in Europe, while in Australia it is exceedingly abundant, attaining a size and beauty which are unknown in our seas.

Busk has described a Polyzoon from Madeira under the name of *Scruparia* (= *Eucratea*) *diaphana**; but, from its mode of branching and the size of the aperture, it would seem to be more properly referable to some other genus.

* Quart. Journ. Micr. Sc. (n. s.) viii., Zoophytol. 281, pl. xxxi. figs. 1, 1a.

EUCRATEA CHELATA, Linnæus.

Plate I. fig. 3; Plate II. figs. 4-8; Plate III. figs. 9-11.

BULL'S-HORN CORALLINE, *Ellis*, Corall. 42, no. 9, pl. xxii. fig. b, B.

SERTULARIA CHELATA, *Linn.* Syst. (ed. 10) 816.

CELLULARIA CHELATA, *Pall.* Elench. 77.

SERTULARIA LORICATA, *Linn.* Syst. (ed. 12) 1316.

CELLARIA CHELATA, *Ellis & Sol.* Zooph. 25: *Lamk.* An. s. Vert. (ed. 2) ii. 189.

EUCRATEA CHELATA, *Lamx.* Expos. Méth. 8, pl. lxxv. fig. 10: *Johnston*, B. Z. (ed. 2) 288-9, woodcut, fig. 64: *Hincks*, Ann. N. H. March 1853, pl. vi. fig. 3; *id.* Devon Cat., Ann. N. H. ser. 3, ix. 23: *Smitt*, Kritisk Förteckn. iii., Öfvers. Vet.-Akad. Förhandl. 1867, 281 & 301: *Gosse*, Dev. Coast, 132.

SCRUPARIA CHELATA, *Oken*, Lehrb. Naturg. Abth. ii. 90: *Busk*, B. M. Cat. i. 29, pl. xvii. fig. 2.

EUCRATEA LORICATA, *Flem.* B. A. 541.

UNICELLARIA CHELATA, *Blainv.* Actinol. 461, pl. lxxvii. fig. 2.

EUCRATÉE CORNÉE, *M.-Edwards*, Ann. Sc. N. sér. 2, ix. Zool. 204, pl. viii. figs. 1, 1 a.

CATENARIA CHELATA, *D'Orbigny*, Pal. Franç. Terr. Crét. v. 43.

Zoarium often much branched; *zoæcia* in the form of a horn, narrowed below, enlarging gradually upwards to the base of the aperture, which slants away to the top of the cell; aperture oval, surrounded by a thin raised unarmed margin; frequently a rudimentary cell below it in front. *Oæcia* mitriform, somewhat pointed above, with a keel down the centre, borne below the aperture on an imperfectly developed cell. *Primary zoæcium* small, destitute of the usual peduncular portion, and terminating below in a short caudate process; aperture narrow, elongate, occupying the whole of the front; cell attached by a short, jointed stem, which originates a little below the aperture.

Var. *α. repens*. *Zoæcia* decumbent and adnate; aperture scarcely marginate; branches given off from the sides of the cells. (Plate I. fig. 3.)

Var. *β. gracilis*. *Zoæcia* very slender and elongate, tubular below and enlarged above.

RANGE OF VARIATION. In an early stage of growth this

species is often decumbent. A few cells are repent and adnate; and from these the erect shoots arise, and the zoarium then assumes its normal condition. But in the remarkable variety *a* the decumbent mode of growth seems to be permanent. I first met with it in the Isle of Man, where it is common, spreading in rather large dendritic patches over oyster and other shells. In this condition the species curiously imitates the habit of *Hippothoa*, Lamx., and sends off branches from the sides of the cells.

Large, much-branched specimens frequently occur, which show no tendency whatever towards an erect growth, but seem to have taken on in permanence the characters of the last-named genus. So completely are the habit and aspect of the Polyzoon changed in this repent variety, that it is difficult to recognize it under its disguise. There are generally, however, a number of the tubular processes rising below the aperture which are so characteristic of *Eucratea chelata*. In this variety the cell is often much produced below, and the aperture is less distinctly marginate than in the erect form.

Smitt has noticed that in Norwegian specimens of the normal habit this character is, as a rule, much less strongly marked than it is in English examples. In beautiful specimens from Australia, where *E. chelata* is abundant, the raised border is highly developed; the cells are large, of most delicate texture, vitreous, transparent, and glossy; the whole aspect of the species has changed under the genial influences of its southern habitat.

The variety *gracilis* is of extremely delicate habit; and the portion of the cell below the aperture is cylindrical and very slender. The upper part, also, has much less breadth than in the normal form; and there is no longer the striking resemblance to a horn.

HABITAT. On weed, shells, stones, crabs, &c., between tide-marks more especially, and in the Laminarian region, and from moderate depths.

LOCALITIES. Common and widely distributed. Ayrshire (Landsb.): St. Andrews, on *Ceramium rubrum* and *Sert. pumila* &c., between tide-marks (Dr. McIntosh): Scarborough, very rare (Bean): Brighton and Hastings, very rare (W. W. Saunders): on all sides of Ireland (W. T.): Northumberland, on small weeds and zoophytes, tide-marks and a little beyond (Alder): south-west of Durham, rare (J. Hogg): Isle of Man; Filey, under stones; South Devon, very common; Salcombe, on *Laminaria digitata*, a favourite habitat, growing amongst the forests of *Obelia geniculata*; St. Ives, Cornwall, of great size and beauty, also on *Laminaria*; Ilfracombe, off the Capstone, 8-10 fath. (T. H.): Connemara, rock-pools (G. S. B.): Shetland (C. W. P.): &c.

Var. *a*. On shells dredged off Maughold Head, Isle of Man (T. H.).

Var. *β*. North Devon (A. Leipner).

GEOGRAPHICAL DISTRIBUTION. Bahusia, 5-10 fathoms; Southern Norway (Smitt): Hougessund, on *Delesseria*, 5-20 faths. (Kirchenpauer): south-west coast of France (Fischer): Bay of Cadiz (Kirchenpauer): Australia, abundant, normal and var. *gracilis* (T. H.).

In this very pretty species the cells are white, smooth and glossy, and are linked together in series, so as to form delicate, somewhat curved, confervoid tufts. At times the shoots are clustered, but generally they are distributed irregularly on the trailing fibre. Ellis gives a good idea of the cell, in likening it to a bull's horn; Couch, on the other hand, sees in it a resemblance to a shoe. The lowest cell in a shoot is generally much pro-

duced below, and annulated towards the base. The form of the ovicells is peculiar and very picturesque; they are broad, rising to a point above, and carinate in front. They seem to be sparingly developed. The creeping stem is very much attenuated; it swells out at intervals, like that of *Aetea*, into somewhat oval expansions, from which the cells originate; but they are small and inconspicuous. Branches are given off from the sides of these enlarged portions, as in the last-named genus. The polypide is very small and delicate, with 10 or 12 tentacles, and is remarkable amongst an active tribe for the vivacity of its movements *. It affords a good example of the simpler type of polyzoan structure, and, from the nature of its cell, is readily examined.

Genus GEMELLARIA, Savigny.

Der. From *gemellus*, double.

GEMELLARIA, Savigny, 1811 : Van Beneden : Johnston, B. Z. : D'Orbigny : Busk, B.M. Cat. : Smitt.

SCRUPARIA β , Oken, Lehrb. 1815.

GEMICELLARIA, Blainville, 1820.

LORICARIA, Lamx. Expos. Méth. 7.

CRISIA (sp.), Lamx. : Lamk.

NOTAMIA, Flem. Br. An. 1828.

LORICULA, Cuvier, 1830.

GENERIC CHARACTER.—ZOARIUM *erect, phytoid*. ZOECIA *joined back to back; the cells composing the pairs rising one from the top of the other, all the pairs facing the same way. Aperture large, on the front of the cell, slightly oblique.*

* I give it this character after many years' acquaintance. It is a most nimble creature; and there is always a fresh interest in watching its pretty ways.

Branches given off from the sides of the cells close to the upper extremity. No vibracula or avicularia. OECIA none.

GEMELLARIA is closely allied to *Eucratea*. The single cell presents the same general character in both; the differences lie in the mode in which the cells are united, the plan of the branching, the total absence, as it seems, of oecia, and the nature of the adherent base, which is not a creeping fibre, or line of adnate cells, as in *Eucratea*, but a mass of interlacing tubes, such as we meet with in the genus *Bugula*. An interesting intermediate form is found in the genus *Scruparia*, mihi.

GEMELLARIA LORICATA, Linnæus.

Plate III. figs. 1-4.

COAT-OF-MAIL CORALLINE, *Ellis*, Corall. 40, no. 7, pl. xxi. fig. b, B.

SERTULARIA LORICATA, *Linn.* Syst. ed. 10, 815.

CELLULARIA LORICULATA, *Pall.* Elench. 64: *Dalyell*, Rem. An. i. 233, pls. xliii. & xliv.

SERTULARIA LORICULATA, *Linn.* Syst. ed. 12, 1314.

CELLARIA LORICULATA, *Ell. & Sol.* Zooph. 24: *Lamk.* An. s. Vert. ed. 2, ii. 179.

SCRUPARIA LORICATA, *Oken*, Lehrb. Naturg. 90.

CRISIA LORICULATA, *Lamx.* Pol. Coral. flex. 140.

LORICARIA EUROPEA, *Lamx.* Expos. Méth. 7.

NOTAMIA LORICULATA, *Flem.* B. A. 541: *Farre*, Phil. Trans. 1837, 413, pl. xxvii. figs. 6-9.

LORICULA LORICATA, *Cuvier*, Règne Anim. ed. 2, iii. 303.

GEMICELLARIA LORICULATA, *Blainv.* Dict. Sc. Nat. lx. 425: *Actinol.* 461, pl. lxxviii. fig. 4.

GEMELLARIA LORICULATA, *Van Ben.* Recherches (sep.), 1845, 33, pl. v. figs. 1-7: *Johnston*, B. Z. ed. 2, 293 & 477, pl. xlvii. figs. 12, 13: *Alder*, North. & Durh. Cat. (sep.) 47.

GEMELLARIA LORICATA, *Busk*, B.M. Cat. i. 34, pl. xlv. figs. 5, 6: *Smitt*, Cefvers. K. Vet.-Akad. Förh. 1867, 286 & 324, pl. xvii. fig. 54.

GEMELLARIA WILLISII, *Dawson*, Proc. & Trans. Nova-Scot. Inst. Nat. Sc. i. pt. 3 (1864-65), Proceed. p. 3.

Zoarium forming large densely bushy masses, several inches in width, of a brown colour, made up of numerous long, slender, tapering shoots*, irregularly branched; branches divided dichotomously. *Zoæcia* elongate, more or less attenuated and produced below; surface minutely pitted; aperture suboval, narrowed towards the bottom, slanting upwards, occupying about half the front, with a thin, raised, and unarmed margin.

Polypide with from 10 to 14 tentacles†.

Height several inches, occasionally as many as 8 or 9, according to Mr. Hassall; more usually 2-4.

HABITAT. From the littoral region to deep water (80 fathoms).

LOCALITIES. Isle of Sheppey, abundant (Ellis and Farre): Shetland, occasionally met with; the Minch (A. M. N.): Kirkcudbrightshire (Landsb.): very splendid on the west coast of Sutherland (C. W. P.): St. Andrews, abundant in deep water (Dr. McIntosh): Bass Rock, 24 fms.; entrance to the Firth of Forth, 22 fms. (Kirchenpauer): Northumberland, very abundant in the Coralline region (Alder): Dublin and Killiney Bays, common (Hassall): north and east coasts of Ireland, common and of large size (W. T.): South Devon, not common; Lancashire coast, Lytham &c., in the greatest plenty; Ilfracombe, off the Capstone, 8-10 fms.; Llandudno, N. W.; Filey, Yorkshire; Oban, common (T. H.): Polperro, near the shore, rare (Couch): Guernsey, after storms (R. S. Cooper).

GEOGRAPHICAL DISTRIBUTION. Scandinavia; Spitzbergen, 3-10 fms. (Smitt): Greenland (Lütken): Hammerfæst, rare, on *Eudendrium ramosum*; Havösund, frequently on

* "Growing much like a poplar tree."—Couch.

† Farre and Van Beneden give 10 as the number, Dalyell 12-14, Sars 12.

stones at extreme low-water mark (M. Sars) : Little Belt, near Fänoe, 10–26 fms. (Kirchenpauer) : Sable Island (*G. Willisii*) (Dawson) : Labrador, 15 fms. (Wallich) : St. George's Banks, 50–85 fms. (Smith & Harger) : White Sea (Mereschkowsky) : Ostend (Van Ben.).

The most striking characteristic, perhaps, of this species is the perfect simplicity of its structure. There is no complexity in the arrangement of the parts ; the general plan is plain and definite and singularly free from variability. There are no accessory appendages ; even the radial fibres, which are generally very susceptible of modification, are of the most rudimentary type.

The cells are at times more elongated below ; and there are slight differences of form, dependent on the degree in which the aperture slopes upward. From about the middle of the front surface, where the cell is thickest, it narrows gradually towards the base ; and from the same point the aperture slants more or less obliquely to the top. The pairs of cells rise immediately one from the other, each cell taking its origin at the back of the one below it, just behind the aperture, as in the genus *Eucratea*. The branches are given off from *each side* of the uppermost pair in a stem, close to the top ; and at times the stem ascends between them, and a triplet is formed in place of the more usual bifurcation. The shoots rise from a trailing bundle of intertwining fibres of considerable thickness, and are themselves composed towards the base of many tubular strands, some of which are carried up along the lower portion of the branches. There is a very great development of the radiciform fibres.

Alder mentions two varieties of this species—"the one rather more rigid, darker-coloured, and with the branches

shorter and more numerous than in the other, which is very flaccid, pale, and with the terminal branches much attenuated."

G. Willisii, Dawson, from the coasts of Nova Scotia, which is said to differ from *G. loricata* "in its narrower and less-inflated cells and longer apertures, and in its more dense habit of growth," seems to me to present only the characters of a variety.

This species has suffered many things at the hands of systematists; and the formidable list of synonyms given above affords a striking illustration of the injury done to zoological science by the unnecessary creation of names.

Genus SCRUPARIA, *Hincks*.

SCRUPARIA (part.), *Hincks*, Quart. Journ. Micr. Sc. v. (1857).

GENERIC CHARACTER.—ZOARIUM *erect*, branches given off from the back of a cell, and facing in the opposite direction. ZOECIA *subcalcareous*, rising one from the other, so as to form a single series, or placed back to back. Aperture small, unarmed, slightly oblique, terminal. OVICELLIGEROUS CELLS *small and imperfectly developed*, placed back to back with the ordinary cells. OECIA *terminal*. No AVICULARIA or VIBRACULA.

THIS genus is founded for *Scruparia clavata*, *mihi*. Further examination has convinced me that its peculiarities are such as to separate it from the well-known *Eucratea chelata*, with which I had previously associated it.

I have adopted for the present genus Oken's name *Scruparia*, which would otherwise lapse altogether. No practical inconvenience, I believe, is likely to result from its retention with a new definition.

In 1858 Dyster established the genus *Huxleya* for a

Polyzoon which he had obtained at Tenby, and named *H. fragilis*; and Norman has since identified this form with *S. clavata*, and has suppressed Dyster's specific name in favour of mine *. Of course, if this decision were well-founded, the present genus would be wholly superfluous.

I am quite unable, however, to adopt the opinion of my friend Mr. Norman in this case. *H. fragilis* and *S. clavata* are, as I shall show, perfectly distinct forms, and, so far as our imperfect knowledge of the former will enable us to judge, are properly referred to different generic groups.

Dyster's description of his *Huxleya fragilis* would be more satisfactory if it were more minute; but the shape of the aperture, which, we are told, is "*rounded or semicircular above, and straight below*," separates the species which he had in view conclusively from *S. clavata*. It is also noticeable that his account of the mode in which the cells are connected could hardly have been suggested by the latter.

We have other important evidence to the same effect in the drawings of the two forms from Mr. Busk's accurate pencil, published in the 'Microscopical Journal.' It is only necessary to compare the figures of *Scruparia clavata* in the fifth volume of the Journal (plate xvii. figs. 5-8) with that of *H. fragilis*, taken from Mr. Dyster's specimen, in the sixth volume (plate xxi. fig. 1), to be convinced that the originals were at least specifically distinct. Not only the shape of the aperture, but its size and position are shown by these figures to be different in the two forms, whilst there is also a striking dissimilarity in the characters of the cell itself, and in the mode of branching. We have, then, two species to deal with.

As to the question of genus, if the principles which I

* Quart. Journ. Microsc. Sc. n. s. viii. p. 212.

have laid down for the definition of genera in this family be correct, we can hardly hesitate to place the species under consideration in different groups.

The plan of the ramification in *S. clavata*, involving, as it does, the frequent occurrence of a biserial arrangement of the zoœcia as in *Gemellaria*, and involving also the remarkable position of the ovicelligerous cell, is, in my judgment, a generic character. The difference in the structure of the aperture is also important. *Scruparia* is, I believe, as distinctive a form in its way as *Gemellaria*.

It may be regarded as intermediate in some respects between the last-named and *Eucratea*. In different states it presents the arrangement of the cells which is characteristic of each of these genera: in some cases they are simply uniserial; in others two lines of cells are united back to back, and we have the general form of zoarium which belongs to *Gemellaria*. Perhaps the uniserial is the more common condition; but intermingled with tall and well developed shoots of this class there are generally others which have assumed either wholly or in part the biserial character. Frequently a shoot occurs in which a few of the cells have others placed back to back with them, while the rest form a single series. A remarkable change also takes place in the cells which are united in pairs: they lose the elongated form which belongs to the uniserial class, and become shorter and less slender in habit, so that the biserial shoots present a very striking contrast in appearance to the uniserial. The cells which carry the ovicells are, as in the genus *Eucratea*, partially developed; they are very short (about half the size of the ordinary cells), and have lost altogether the characteristic form of the species. They are always placed back to back with another cell, except in the case of biserial shoots, on which they are often, though

not universally, developed at the *side*. Even on these, however, they are not unfrequently intercalated amongst the other cells.

The branches are given off from the dorsal surface, rising from about the middle of it; and *the cells composing them face in the opposite direction from those of the parent shoot*. It is evident that the ovicelligerous cell is in most cases the first element of a branch, which is usually appressed to the shoot from which it rises, and united to it. Occasionally, however, it remains free, and stands out obliquely from it, showing clearly its real significance. It should be remarked that in *Eucratea* also the ovicelligerous cell occupies the position of a branch, and is in fact the first element of one, modified for the discharge of a special function.

To a change, then, in the plan of the ramification may be due the passage of the *Eucratea*-form into the *Gemellaria*-form. The branch which in the former genus is given off in front originates in *Scruparia* at the back, and in many cases becomes adnate to the shoot from which it rises; and we thus have as an occasional condition the form of zoarium* which is universal and permanent in *Gemellaria*.

The first cells of the colony are repent, as in *Eucratea*, forming a series of greater or less length, adnate to the surface on which the Polyzoon grows, from which the erect shoots arise.

SCRUPARIA CLAVATA, Hincks.

Plate III. figs. 5-8.

SCRUPARIA CLAVATA, *Hincks*, Quart. Journ. Micr. Sc. v. 175, pl. xvii. figs. 5-8.

* *Essentially* the same form, but with this difference—that in *Scruparia* the cells are subalternate, while in *Gemellaria* they are exactly opposite.

Zoarium sparingly branched. *Zoæcia* sometimes uniserial, sometimes in two series placed back to back, elongate, clavate, rounded at the top and attenuated downwards; each cell attached to the dorsal surface of the one below it, at some distance from the top, by a cordate expansion of the base; aperture suborbicular, slightly produced and contracted below, not marginate. *Oæcia* globose, with a few rather large punctures.

RANGE OF VARIATION. I have noticed the principal variations to which this species is liable in the remarks on the genus, and shall merely add the following detailed observations by way of illustration.

1. A line of eleven cells; from the third above the base, a branch given off, and also from the sixth. Immediately below the higher branch a pair back to back, and immediately above it a pair, then an ovicelligerous cell. Also a pair immediately below the top cell.

2. A line of about seven cells; at the top two pairs back to back, and four ovicelligerous cells, two on each side, so that the shoot at this point exhibited four rows of cells.

3. A normal cell at the base, then two pairs back to back, and an ovicelligerous cell at one side on the line of junction.

4. A long line of cells, the third being of the shorter form, and this alone having another cell back to back with it.

5. A line of seven cells; the fourth and fifth giving off cells at the back.

6. A normal series, with one or two ovicelligerous cells at intervals on the dorsal surface.

HABITAT. On other Polyzoa in shallow water.

LOCALITIES. Lamash Bay, Arran; Filey Bay, off the Brigg, chiefly on *Crisidia cornuta*, abundant; on *Cellularia*

Peachii either from Shetland or the Northumberland coast, probably the former (T. H.).

Scruparia clavata is a free grower: in Filey Bay, where it is abundant, it spreads luxuriantly over the tufts of *Crisidia*, creeping along the stems, and sending off its linked cells at intervals as erect and slender shoots. It presents a curious diversity of appearance—now a single series of graceful elongate cells, now a double line in which the cells are shortened and the general aspect is completely changed. The ovicells are plentifully developed.

The aperture is small, resembling that of a Lepralian cell; and the oral valve occupies more than two thirds of its area.

Genus HUXLEYA, *Dyster*.

Der. Named in honour of Prof. Huxley.

HUXLEYA, Dyster, Quart. Journ. Micr. Sc. vi. (1858), 260.

GENERIC CHARACTER.—ZOARIUM *corneous or subcalcareous, dichotomously branched, the branches given off from the top or side of a cell, and facing in the same direction. ZOECIA uniserial; orifice small, subterminal, unarmed.*

I HAVE somewhat altered Dyster's generic character. It represents the cells as biserial; but Mr. Busk's figure shows that this is not the case in any true sense. We have no direct information respecting the mode in which the zoarium is attached; but Mr. Busk represents tubular processes as given off from the sides of two of the cells; and we may, I think, infer from their presence that *Huxleya*, like *Gemellaria* and *Brettia*, is attached by radicleform fibres and not by a creeping base.

HUXLEYA FRAGILIS, Dyster.

Plate II. fig. 1.

HUXLEYA FRAGILIS, *Dyster*, Quart. Journ. Micr. Sc. vi. 260, pl. xxi. figs. 1, 2.

Zoarium much branched, white and flexible, from half an inch to one inch high. *Zoæcia* pyriform, rounded above, narrowed but usually not much produced below, each cell rising from the top of the one beneath it; orifice placed on the front of the cell, just below the top, very small, semicircular, with a straight lower lip; the margin unarmed and not thickened. *Oæcia* unknown.

Polypide with 10 tentacles.

LOCALITY. Tenby (*Dyster*).

The differences between this species and *Scruparia clavata* have already been pointed out. In this genus the oral valve is no longer placed at the top of a membranous area of greater or smaller size, but occupies the whole of the orifice and is immediately enclosed by the wall of the cell. The orifice is a simple semicircular opening, and seems not to be placed obliquely. The zoæcia in this species are not much attenuated and produced below, but are somewhat short and stout, and consequently present a much less elegant appearance than those of *Eucratea* and *Scruparia*.

Genus BRETTIA, *Dyster*.

Der. Named after Mrs. Brett.

BRETTIA, *Dyster*, Quart. Journ. Micr. Sc. vi. (1858).

GENERIC CHARACTER.—*ZOARIUM erect, corneous, branched, branches given off from the top of a cell a little to one side, and facing in the same direction as the cell. ZOÆCIA uniserial, elongate, subtubular; aperture terminal or sub-*

terminal, large, with the oral valve at the upper extremity ; margin armed with spines. OECIA unknown.

FROM *Scruparia* this genus is distinguished by its mode of branching and its constantly uniserial habit, by its sub-tubular cell, and large spinous aperture. From *Huxleya* it is separated by the shape and structure of the aperture and by its elongate subcylindrical cell.

BRETTIA PELLUCIDA, Dyster.

Plate IV. figs. 6, 7.

BRETTIA PELLUCIDA, *Dyster*, Quart. Journ. Micr. Sc. vi. (1858), 260, pl. xxi. figs. 3-5.

Zoarium perfectly transparent, about half an inch high.

Zoecia much elongated, subcylindrical, slightly expanded towards the aperture ; aperture placed on the front of the cell, at its upper extremity, oval, rounded above, pointed below, with five to nine marginal spines, irregularly arranged. *Oecia* unknown.

Polypide with 10 tentacles.

HABITAT. On stone between tide-marks.

LOCALITY. Tenby (Mrs. Brett : Dyster).

Nothing is known of this minute but characteristic form beyond what we learn from Mr. Dyster's brief description and Mr. Busk's excellent figure, which I am permitted to copy for this work.

BRETTIA TUBÆFORMIS.

Plate II. fig. 2 ; Plate V. fig. 1.

BRETTIA PELLUCIDA, *Norman*, Rep. Brit. Assoc. 1866, 196 & 199.

Zoarium minute, transparent, dichotomously branched, surface smooth, attached by a number of tubular fibres.

Zoæcia elongate, somewhat trumpet-shaped, slender and tubular below, and expanding gradually upwards, with a distinct joint a little above the base; aperture terminal, slightly oblique, suborbicular, with about ten short spines round the margin. *Oæcia* unknown.

Height about $\frac{1}{8}$ inch.

LOCALITIES. South-east coast, on *Fucus* (R. S. Boswell): the Minch, Hebrides (A. M. N.).

Many years since, I received from Mr. R. S. Boswell a drawing of this form, which he had found on the English coast; but as it was unaccompanied by specimens, I was unwilling to publish it. In the mean time Mr. Norman dredged in the Minch a minute fragment of a species which he referred, in his Report on Hebridean Polyzoa &c., to *Brettia pellucida*, Dyster. He was good enough to intrust it to me for examination; and it was with great pleasure that I recognized in it the species represented in Mr. Boswell's characteristic sketch (Plate V. fig. 1).

B. tubæformis is readily distinguishable from *B. pellucida* by the shape and proportions of the cell, and by the terminal position of the aperture. The zoæcium expands regularly from the slender base towards the top; and the upper portion is broader as compared with the lower than in the last species. The cell of *B. pellucida* is almost cylindrical, that of *B. tubæformis* has the form, as its name denotes, of a trumpet. The position of the aperture at its summit, looking obliquely upwards, also produces a marked change in the general appearance. In *B. pellucida* it is placed on the front surface immediately below the top. In one case it is suborbicular in form, in the other obovate*.

The branching is dichotomous and perfectly simple.

* Mr. Boswell states (*in litt.*) that the oral spines are movable.

The radical fibres are shown in Mr. Boswell's figure ; and they are also present in Mr. Norman's fragment. They originate at various points on the surface of the lower cells.

Family III.—Cellulariidæ.

CELLULARIDÆ, (part.), Johnston, Br. Zooph.

CELLULARIADÆ, Busk, B.M. Cat.

CABEREADÆ, id. *ibid.*

CELLULARIÆ (part.), Smitt, Krit. Förteckn., Öfvers. Skand. Hafs-Bryozoer.

ZOÆCIA in two or more series, closely united and ranged in the same plane ; avicularia and vibracula, or avicularia only, almost universally present, sessile. ZOARIUM erect, dichotomously branched.

IN this family the stems and branches which compose the plant-like zoarium are formed of lines of cells placed side by side in the same plane, and intimately united. The structure is compact, and there is no tendency to the free and lax habit of growth which characterizes the next group (*Bicellulariidæ*). The cells are generally either sub-oval above, and more or less produced and narrowed below, or subquadrangular. The aperture, which is usually armed with spines, and often protected by an opercular plate (modified spine), is placed on the upper portion of the front of the cell, and is for the most part directed straight downwards. It is elliptical or oval in form, and usually closed in entirely by a membrane ; but in a few cases it is partially covered by a calcareous lamina.

As a rule the various appendicular organs are developed abundantly in this group. The marginal spines are often present in profusion, attaining a very large size, and assuming (as amongst the *Menipeæ*) very fantastic forms.

The avicularia are of the sessile and fixed type, and exhibit, on the whole, a very constant and definite arrangement. They are either disposed along the outer edge of the cells or on the front surface. The lateral avicularia are seldom absent, though where the median appendages are highly developed, they are more or less atrophied, and in some cases dwindle into complete insignificance. They are either attached to every cell, or each internode (in the jointed forms) carries a certain number.

The vibracula are less universally present; but in certain sections of the family they attain a remarkable degree of development, and exhibit, perhaps with one exception, their most highly specialized form.

The radical fibres, by means of which the tufted zoaria are attached, exhibit many interesting modifications, corresponding strictly in some cases with the nature of the habitat, and assuming at times in the same species, under different circumstances, very different adaptive forms. I have referred to some of these curious modifications in the account of *Scrupocellaria reptans**.

Though the family of the *Cellulariidæ* is properly described as rich in the secondary appendages, it possesses in the genus *Cellularia* a representative which is chiefly distinguished by the simplicity of its structure, and connects it with the still simpler group of the *Eucratiidæ*.

In defining the limits of the present family, I have not ventured to exclude the remarkable genus *Caberea*, although it presents some very striking peculiarities, and is distinguished from the rest of the tribe by the non-articulated character of its zoarium. In other points of

* These interesting adaptations are not confined to this family. A remarkable instance of similar plasticity in the radical appendages is furnished by *Bugula plumosa*.

structure there is the closest agreement between it and *Scrupocellaria*. The avicularia occupy the same positions in both, and though the vibracula are more highly developed in *Caberea*, they are essentially the same in structure as those of the other genus. We have also a link between the two forms in the *Canda arachnoides*, Busk, an articulated species, in which the vibracular cells are of large size, and stretch diagonally across two thirds of the length of the zoæcium.

The non-articulated condition of the zoarium does not appear to be a point of so much significance as to warrant the separation of *Caberea* from forms with which it has such a close general affinity.

I retain the genera *Cellularia*, *Menipea*, and *Scrupocellaria* as defined by Busk and Wyville Thomson, instead of uniting them, with Smitt, in a single division. The differences between them lie chiefly in the presence or absence and in the disposition of the appendicular organs (avicularia and vibracula). As there is undoubtedly much variability in these particulars, as the avicularia for instance are often present on some cells and absent on others within the limits of one and the same colony, and in some species are now present and now altogether wanting, it may be urged that these distinctions are purely arbitrary*. But it must be remembered that, with our present knowledge of the Polyzoa, a perfectly natural arrangement is unattainable, and that these groups are probably as good for their purpose as any that can be substituted for them. They represent some of the principal modifications of the family type; and in point of fact each of them has, on the whole, a distinct and characteristic *facies* of its own.

* *I*de "Floridan Bryozoa," by Prof. Smitt, part i. p. 16 (Kongl. Svenska Vetensk.-Akad. Handl. Band x. No. 11).

Genus CELLULARIA, Pallas.

Der. From *cellula*, a diminutive of *cella*, a cell.

CELLULARIA, Pallas, Elench.: Busk: Smitt, part.

BUGULA (part.), Gray.

GENERIC CHARACTER.—ZOARIUM *jointed*. ZOÆCIA *in two or three series, many in each internode, contiguous; dorsal surface perforated*. AVICULARIA and VIBRACULA *usually wanting; occasionally an avicularium on a few of the cells in an internode*.

THERE would seem to be no special reason for the appropriation of Pallas's name to this particular type; amongst the miscellaneous assemblage of forms which he has ranged under it, there is probably not one referable to *Cellularia* as here defined. But it is clearly most desirable to avoid any change of established nomenclature which is not imperatively called for; and as all the members of Pallas's genus seem to have a home elsewhere, there can be no objection to the new application of his classical name which we owe to Mr. Busk.

The only British member of this group is totally destitute of appendicular organs, and is remarkable for the neatness and simplicity of its structure. The allied Australian species, *C. cuspidata*, closely resembles it in general character; but in *C. ornata*, Busk, we meet with avicularia, which, however, are most sparingly developed and of a peculiar type. So far as my observation goes, they occur only on three of the uppermost cells in each internode. They occupy a small triangular area, and are furnished with a semielliptical mandible.

I am inclined to think that we must regard both *Cellularia* and *Menipea* as descended from forms furnished

with vibracula; they seem still to retain some obscure traces of these organs. In the latter the claspers or tendril-like fibres originate (in some cases at least) from a small swelling on the upper part of the zoœcium, which occupies the usual position of the vibracular cell, and is probably the remains of one. In the present genus it is represented by a simple pore, from which the radical fibres proceed.

CELLULARIA PEACHII, Busk.

Plate V. figs. 2-5.

CELLULARIA PEACHII, *Busk*, Ann. N. H. (2nd ser.) vii. 82, pl. viii. figs. 1-4; B. M. Cat. i. 20, pl. xxvii. figs. 3, 4, 5: *Smitt*, Kritisk Förteckn., Öfvers. af Kongl. Vetensk.-Akad. Förhandl. 1867, no. 5, 285 & 322, pl. xvii. figs. 51-53.

CELLULARIA NERITINA, var., *Johnst.* B. Z. 340 (teste *Busk*).

BUGULA NERITINA, var. *b, c, d, e*, *Gray*, B. M. Cat. Radiata, 114.

Zoarium white and glossy, dichotomously branched, forming slender phytoid tufts. *Zoœcia* biserial, alternate, elongate, attenuated downwards, with a small spine on the upper and outer angles, frequently wanting; aperture oval, sometimes much lengthened, and narrowed below, occupying about two thirds of the front of the cell; margin thickened slightly, and minutely granular; dorsal surface smooth, with 3-5 perforations; commonly a spine on the summit of the median cell at each bifurcation. *Oœcia* subglobose, surface tessellated.

RANGE OF VARIATION. The cells are more or less produced below; and the shape of the aperture varies from a pretty regular oval to an elongated form, narrowed towards the bottom. The *granulated* margin is not always present; and the marginal spine is very frequently wanting.

HABITAT. On stones, shells, zoophytes, &c., from deep water chiefly.

LOCALITIES. Peterhead; Wick, rare (C. W. P.): Buchanness; Tynemouth; Copinstra (Lieut. Thomas): Northumberland, from the five-men boats, not uncommon (Alder): Shetland, haddock-grounds and Outer Haaf, frequent (A. M. N.): Scarborough (Bean): Aberdeenshire (Dawson).

GEOGRAPHICAL DISTRIBUTION. *Bahusia* (Lovén); Spitzbergen, Henloopen, 30–60 fathoms; King's Bay, muddy bottom 200–250 fathoms (Torell and Swedish Expedition, 1861): South Labrador, rare (Packard): Hamilton's Inlet, Labrador, 15 fathoms (Wallich): Gulf of St. Lawrence (Dawson): St. George's Banks, 150 fms. (Smith and Harger).

In this species the two rows of cells do not present a perfectly plane surface; each of them slopes slightly outwards, so that the central line of junction appears elevated, and the front of the shoot somewhat carinate. We may recognize in this, as in other points of structure, an approach to the genus *Nellia*, Busk, in which four series of cells are so united as to form a subcylindrical shoot. The present form has the closest affinity with the last-named genus, the cells of the two being identical in character; and if we were to imagine two shoots of *Cellularia* placed back to back and united, we should have a zoarium very like that of *Nellia simplex*, Busk.

Cellularia Peachii is furnished with a great number of very long tubular fibres, more or less annulated, which are given off from the dorsal surface, chiefly towards the lower part of the shoots. Many of them are perfectly simple; but others terminate in a number of fibrils or rootlets, by means of which they adhere. The shoots are

divided into segments, which are united by corneous joints. There are usually about 7-9 cells in each internode; but the number varies. Branches are given off dichotomously; and at each bifurcation an additional cell is interposed, occupying the space between them at their point of origin, which is surmounted by a short acuminate spine. Mr. Busk makes the presence of this cuspidate process a distinctive mark of the Australian species *C. cuspidata*, but it belongs to *C. Peachii* as well.

Genus MENIPEA, *Lamouroux*.

Der. From *Menipea*, one of the Nereids, according to Hesiod.

CELLARIA (part.), Linnæus.

MENIPEA, Lamx. Bulletin Soc. Phil. 1812; Pol. Cor. flex.: Busk: Wyville Thomson, Dublin N.H. Rev. July 1858.

CRISIA (part.), Lamouroux.

TRICELLARIA, Fleming, Br. An.

CELLULARIA (part.), Johnst. Br. Zooph: Smitt.

CELLARINA (part.), Van Beneden, Bull. Ac. Roy. Belg. 1849.

EMMA, Gray: Busk.

GENERIC CHARACTER.—ZOÆCIA *oblong, widest above, attenuated and often elongated downwards; imperforate behind, with a sessile lateral avicularium (often wanting), and usually one or two avicularia on the front of the cell. No vibracula. ZOARIUM jointed.*

THE type of Lamouroux's genus *Menipea* is the *M. cirrata**, a large species with six cells to the internode. More commonly they are disposed in triplets; and the division of the zoarium into short segments, each carrying a small cluster of cells, may be regarded as a characteristic of the group, though there are certain exceptions.

* The curled branches from which it takes its name are a striking feature of the genus.

Menipea is distinguished from the *Scrupocellariæ* by the total absence of vibracula ; but it also differs from them markedly in habit and what may be called its general expression.

The *Menipeæ* are, for the most part, climbers ; and the (so-called) radical fibres are modified, in most cases, so as to act as prehensile organs. This is the case with our own *M. ternata*, and with all the smaller kinds. The branches too are incurved or curled towards the extremities, and twine around zoophytes and algæ like tendrils. The habit of the group is irregular and straggling ; it exhibits much of the freedom of growth and wild luxuriance which characterize the tribe of creepers amongst plants. In all this it contrasts with the kindred group of the *Scrupocellariæ*, which are much stiffer and more compact in habit, and generally erect in their mode of growth, and which are never climbers.

Certain sections of the *Menipeæ* are also distinguished by the high degree of development which the corneous joints, connecting the clusters of cells, attain amongst them. This is remarkably the case in the very characteristic and beautiful group of species which occurs in the Australian seas. In these the tube which links together the internodes is often of very considerable length, and the glittering triplets or doublets of cells appear as if strung on a slender thread. So transparent are they and sparkling, that they might be wrought in crystal ; over the aperture there often bends a pretty antler-like operculum, while the margin bristles with tall curved spines, which seem to embower the little mansion. These spines are always attached to the edge of the aperture by horny joints.

Australian algæ are abundantly wreathed and adorned by the various members of this attractive group.

In the larger species the characteristics just referred to are much less strongly marked, and there is a tendency towards a much stouter and more erect habit.

The *Menipeæ* are widely distributed. A small group occurs in the Arctic Seas, of which two forms at least range to the North-American coast (Gulf of St. Lawrence and Bay of Fundy). In these northern regions they grow vigorously, and seem to produce their ovicells much more freely than in more genial climes. They have also occurred at the extreme point of the South-American continent (Tierra del Fuego and Falkland Islands), in New Zealand and Australia, where they are well represented, and in South Africa. The Arctic species are closely related to *M. ternata*, and offer a decided contrast in several points to the Australian forms. The ovicells of one of the latter Sir Wyville Thomson describes as immersed; and if this character should be general throughout the southern group, it may perhaps have a claim to generic rank.

MENIPEA TERNATA, Ellis and Solander.

Plate VI. figs. 1-4.

CELLARIA TERNATA, *Ell. & Sol.* Zooph. 30.

CRISIA TERNATA, *Lamæ.* Pol. Cor. flex. 61.

TRICELLARIA TERNATA, *Flem.* B. A. 540: *Gray*, B. M. Cat. Radiata 113.

CELLULARIA TERNATA, *Johnst.* B. Z. (ed. 2) i. 335, pl. lix.: *Smitt*, Krit. Förteckn. iii. 282 (1867).

CELLARINA GRACILIS, *Van Een.* Bull. Ac. Roy. Belg. xv. 7 (sep.), pl. x. figs. 1, 2.

MENIPEA TERNATA, *Busk*, B. M. Cat. i. 21, pl. xx. figs. 3-5.

Zoarium confervoid, forming delicate white bushy tufts, dichotomously branched, the branches straggling; internodes consisting of a triplet of cells. *Zoæcia* elon-

gated, much attenuated downwards; aperture oval, occupying a small proportion of the length of the cell, with three spines, two at the top and one some way below it on the outer margin; operculum small, entire, variable in shape. *Lateral avicularia* large and prominent, generally present on the two lower cells in the internode; one anterior avicularium on each cell, immediately below the aperture, or, very commonly, on the uppermost cell alone, minute, raised; mandible directed downwards. *Oæcia* elongated, smooth.

Radical fibres simple, given off from the lower parts of the shoots; many of the branches furnished with long tendril-like claspers, originating from the side of a cell immediately above the lateral avicularium, near the top of the internode, enlarged and curled above and open at the free extremity.

Primary cell short, cup-shaped, with a round terminal aperture surrounded by 10 or 11 spines.

RANGE OF VARIATION. The cells are sometimes much more elongated than at others, or, I should rather say, the two lower cells in the internode, for the uppermost, which is placed at the bifurcation, is always shorter than the rest, and does not appear to change much. The elongation of the cells of course gives a more slender and graceful habit to the shoots. The specific character given above is founded on what seems to be the usual normal form. Occasionally an internode occurs consisting of 4-7 cells, the rest being the usual triplets; but such cases seem to be very rare. The variety *gracilis*, described by Smitt from the Arctic seas, has universally a large number of cells in each internode; the cells are shorter, straighter, and of more equal width throughout than in the present form; the lateral *avicularia* are very small, and both the spines and opercula seem to be sparingly developed. I believe that this form, of which I

have received abundant specimens, through Dr. Dawson, from the Gulf of St. Lawrence, is properly accounted a variety. It differs very slightly from *M. arctica*, Busk*.

The lateral avicularium is not developed on the uppermost cell, but is usually present on both the others, occasionally only on one of them. It varies much in size: sometimes on the same internode one of the avicularia is very much larger than the other, attaining comparatively gigantic dimensions. On the whole the size of the lateral appendages is remarkable in this species. The anterior avicularium I have generally found on the front of the terminal cell above, and nowhere else. But it is sometimes developed on every cell, and is so figured by Busk. It is very minute, as we should expect, considering the large size of the lateral appendages. The changes in the form of the operculum are simply due to differences in the stage of development. Regarded morphologically, it is a modified spine; and in its first stage it appears as a simple spinous process. It gradually expands into a broad protective shield or lamina; as it enlarges extension takes place chiefly in the direction of the bottom of the cell. When mature it is suboval or somewhat wedge-shaped. The spines vary in number. There are sometimes three or four, frequently only two. One of them is usually placed some way down on the outer margin, almost fronting the operculum; and it is often enormously developed, exceeding the internode in height.

² HABITAT. On Algæ in the littoral zone, and on various Hydroida (chiefly), shells, &c. from shallow to deep water (100 fathoms).

* I have received from Mr. Peach two or three minute fragments of a *Menipea* from Shetland, in which the form of the cells is that of the *gracilis* variety. They also show a larger number in the internode than is characteristic of the normal *M. ternata*. But their condition is too imperfect to allow me to determine whether they should be referred to this variety, or to one of the closely related forms *M. arctica* and *M. Smittii*.

LOCALITIES. Aberdeen (Dr. Skene) : Scarborough, deep water, on a valve of *Cytherea* and on Hydroids, not rare (Bean) : Filey, very abundant on zoophytes (T. H.) : Stonehaven (Lady Keith Murray) : Northumberland, from the deep-water boats, occasionally (Alder) : Cullercoats, rare (Alder and Coppin) : St. Andrew's, from the deep water of the bay (Dr. M'Intosh) : Peterhead and Wick (C. W. P.) : Shetland, on *Tubularia indivisa*, from 70 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. South Labrador (Packard) : Hamilton's Inlet, Labrador, 15 fathoms (Wallich) : Greenland (A. M. N., 'Valorous' dredg.) : off Fredericks-haab, 100 fathoms, not uncommon ; Reykjavik Harbour, Iceland, 15-20 fathoms (Wallich) : ? Grand Manan, 20 fathoms, shelly bottom (Stimpson) : Gulf of St. Lawrence (Dawson) : St. George's Banks, 28-85 fathoms (Smith and Harger) : Scandinavian coasts, chiefly on Algæ in the littoral region (Smitt) : Hammerfæst ; Lofoten (Sars) : White Sea (Mereschkowsky) : West of Jütland, 10 fathoms (Kirchenpauer) : Belgium (Van Beneden).

This attractive species is essentially a climber. Its favourite habitat is on the larger Hydroida (*Hydrallmania*, *Sertularia argentea*, &c.), to which it binds itself by its numerous clasps, twining amongst their branches and festooning them with its delicate pearly tufts. The tubular fibres, which on the lower portions of the shoot are simply adherent, are modified on the higher branches for the discharge of a different function. They are thickened and curled at the extremity, and converted into tendrils, which bear a close resemblance to the similar appendages on *Diphasia fallax* and other Hydroids. These clasps are distributed in considerable numbers over the branches.

They originate at the base of a swelling on the side of the zoœcium, just above the lateral avicularium, which is

probably the remains of the vibracular cell. It still retains the general form of the latter, but has lost its distinctive structure. In *Cellularia* all trace of it has disappeared with the exception of the pores from which the radicleform fibres originate, and which are present on every cell.

M. ternata sometimes attains the height of an inch or more, but is generally of smaller size.

MENIPEA JEFFREYSII, Norman.

Plate IX. figs. 1, 2.

MENIPEA JEFFREYSII, *Norman*, Quart. Journ. Micr. Sc. 1868, (n. s.) viii. 213, pl. v. figs. 4-8*.

Zoarium dichotomously branched; internodes short (4-7 cells). *Zoæcia* biserial, alternate, elongated and narrowed below; aperture regularly oval, margin a little raised, with 3 (or 4) spines at the top; operculum entire. *Lateral avicularia* small and inconspicuous, placed immediately below the spines; on the front of the cell below the aperture, a raised *avicularium*, with pointed mandible, directed downwards. *Oæcia* subglobose, smooth.

LOCALITY. Shetland (C. W. Peach). A few minute fragments only were obtained, among sand dredged in Shetland by Mr. Jeffreys and Mr. Norman.

We know nothing as yet of the size or general habit of this species. The diagnosis is founded on a mere fragment kindly lent me by Mr. Norman. There is nothing very marked in the minute characters; the raised and prominent avicularium at the base of the aperture is perhaps the most striking feature.

I have found it difficult to determine the exact number of the spines, from the condition of the specimen; but it

* In fig. 8 the operculum is erroneously represented as lobed.

seems not to exceed three, except in the case of the terminal cell at the bifurcation of the branches, which bears an additional one in the centre of the upper margin. Two are generally present on the outer side of the cell at the top; and immediately beneath these is placed the very small lateral avicularium. A single spine is also developed, I believe, close to the pedicle of the operculum. The operculum originates very high up on the margin of the cell, and tends somewhat obliquely downwards; the lamina expands almost exclusively below, and fills in the inferior portion of the aperture. The surface of the zoarium is smooth and shining.

Menipea Smittii, Norman (= *Cellularia ternata*, forma *duplex*, Smitt), a Spitzbergen species, is nearly allied to the present form, but differs from it in not being furnished with either operculum or spines.

Genus SCRUPOCELLARIA, *Van Beneden*.

Der. From *scrupus*, a stone, and *cella*, a cell.

SCRUPOCELLARIA, Van Beneden, "Recherches" &c. 1844.

BICELLARIA, sp., Blainville.

CELLULARIA, sp., Pallas : Johnston : Smitt.

CELLARIA, sp., Ell. & Sol. : Lamk.

SCRUPARIA, sp., Oken.

CANDA, sp., Busk.

GENERIC CHARACTER.—ZOARIUM *jointed*. ZOÆCIA *numerous in each internode, rhomboid; aperture with or without an operculum; a sessile avicularium placed laterally at the upper and outer angle, and a vibraculum in a bend or sinus on the lower part of the dorsal surface; frequently an avicularium on the front of the cell.*

SOME of the differences between this and the preceding genus have already been pointed out. The leading cha-

rafter of *Scrupocellaria*, and that which gives it its distinguishing *facies*, is the association of a lateral avicularium and a dorsal vibraculum on each cell. The position of these appendages is very constant; and though one or the other may be occasionally absent, they are generally to be met with on most of the cells in a colony. They vary much, under differing circumstances, in the degree in which they are developed. The lateral avicularium, which is sometimes almost gigantic, is occasionally so much atrophied as to be hardly distinguishable. The cause of the reduced condition in such cases may be found in the size and number of the avicularia on the front of the cell, which have superseded it by discharging its functions. The vibracula also are sometimes much below the normal size, but seem to be less liable to variation than the avicularia. In one species from the Gulf of St. Lawrence and also (I believe) from the Mediterranean, the vibracular cell is unusually large, stretching completely across the back of the zoecium to the median line, and traversed throughout by the groove or fissure, in which the vibraculum itself rests. This form makes an approach to *Caberea*.

The habit of the *Scrupocellariæ* is erect, and their mode of growth regular and somewhat stiff. The internodes are long, and the corneous joints but slightly developed. They want the graceful curled extremities of the *Menipeæ*; and the prehensile appendages of the latter are supplanted by modifications of the fibrils, which act chiefly as organs for fixing the zoarium in its place. Instead of tendrils and claspers we have grapnels.

The *Scrupocellariæ* form a rather large group, and are widely distributed. *S. scruposa*, which is so common in the seas of Europe, ranges from Norway to New Zealand. The genus is represented sparingly in the Arctic seas

and on the Northern shores of America; but the number of species increases in more southern latitudes. About twenty are known. The genus has been traced back in time as far as the Miocene deposits of Austria.

a. *Without an operculum.*

SCRUPOCELLARIA SCRUPOSA, Linnæus.

Plate VII. figs. 8-10.

CREEPING STONY CORALLINE, *Ellis*, Corall. 38, no. 4, pl. xx. c. C.

SERTULARIA SCRUPOSA, *Linn.* Syst. 1315.

CELLULARIA SCRUPOSA, *Pall.* Elench. 72: *Flem.* B. A. 539: *Reid*, Ann. N. H. Dec. 1845, 388, pl. xii. figs. 6, 7: *Johnston*, B. Z. ed. 2, 336, pl. lviii. figs. 5, 6: *Smitt*, Kritisk Förteckn. iii. 285 & 320, pl. xvii. figs. 42-50.

CELLARIA SCRUPOSA, *Ellis & Sol.* Zooph. 23: *Lamk.* An. s. Vert. ed. 2, ii. 192.

SCRUPARIA SCRUPOSA, *Oken*, Lehrb. Naturg. Zool., Abth. 2, 90.

CRISIA SCRUPOSA, *Lamx.* Cor. 60.

BICELLARIA SCRUPOSA, *Blainville*, Actinol. 459.

SCRUPOCELLARIA SCRUPOSA, *Van Ben.* Recherches, 43 and 50, pl. v. figs. 8-16: *Busk*, B.M. Cat. i. 25, pl. xxii. figs. 3, 4: *Gray*, B.M. Cat. Radiata, 111.

Zoarium rather stout, dichotomously branched, internodes of moderate length (7-11 cells), forming large bushy tufts, of a white colour. *Zoæcia* biserial, alternate, rather short, ovate, produced and slightly narrowed below; aperture regularly elliptical, occupying more than half of the front, with a thin margin, and two slender spines on each side above, often of considerable length. *Lateral avicularia* large and prominent, with a slightly hooked beak, which is toothed; no avicularia on the front of the cell. *Vibracular cell* erect, narrow, aperture perpendicular. *Oæcia* small, with a smooth surface, inclining inwards.

Radical fibres slender, smooth, given off from the lower part of the zoarium, adherent by means of a terminal

enlargement (without fibrils); or furnished with hooks.

Primary cell with a round aperture and eight marginal spines, four on the upper border and four in front.

Polypide with 12 to 16 long tentacles, of a light orange colour.

HABITAT. Between tide-marks, under stones &c., and on *Laminaria*, *Flustra*, stones, shells, zoophytes, &c. from shallow to deep water (40–80 fathoms, Shetland).

LOCALITIES. Generally distributed round our coasts.

GEOGRAPHICAL DISTRIBUTION. Ostend, on *Flustra* (Van Beneden): French coasts (Kirchenpauer): North Sea to Bahusia and Middle Norway, common (Smitt): Heligoland; Iceland; North America (Kirchenpauer): Adriatic, common (Grube and Heller): Lyall's Bay, New Zealand (F. W. Hutton).

RANGE IN TIME. Coralline crag (A. Bell): Scotch Glacial deposits (Geikie).

This is one of our commonest Polyzoa. Its nearest British ally is *S. elliptica*; but, as I have pointed out in the account of that species, the two are distinguished from one another by a group of well-defined differences. The lateral avicularia in the present species are very fully developed, compensating, we may suppose, by their size and prominence for the total absence of auxiliary organs on the front of the zoarium. They are smallest at the base of the internodes, and increase in size as they approach the top.

SCRUPOCELLARIA ELLIPTICA, Reuss.

Plate VI. figs. 5, 6.

SCRUPOCELLARIA ELLIPTICA, Reuss, Fossil. Bryoz. d. österreich.-ungar. Mio-cäns, 8, plate ii. figs. 1–9.

SCRUPOCELLARIA INERMIS, *Norman*, Rep. Br. Assoc. 1866, 203; *id.* Quart. Journ. Micr. Sc. 1868, (n. s.) viii. 215, pl. v. figs. 1-3.

Zoarium rather stout, yellowish horn-colour, dichotomously branched. *Zoæcia* oblong; aperture elliptical, with a broad flattened margin, destitute of spines and operculum. *Lateral avicularia* not prominent; no avicularia on the front of the cells. *Vibracular cell* subtriangular, scarcely so broad as high, aperture stretching diagonally downward and inward. *Setæ* short. *Oæcia* smooth, imperforate, inclining inwards. Height about $\frac{1}{2}$ inch.

HABITAT. Moderately deep water.

LOCALITIES. 5-8 miles off Balta, in 40-50 fathoms, rare; the Minch, Hebrides (A. M. N.): Shetland (C. W. P.) *.

RANGE IN TIME. Austro-Hungarian Miocene (Reuss).

S. elliptica is not unlike *S. scruposa* in many respects, but is clearly distinguished from it by the broad and flattened margin of the apertures, the absence of spines, the somewhat less prominent lateral avicularia, and, above all, the broad, triangular vibracular cells, with their slanting apertures. The last is certainly the best distinctive character.

There can, I think, be little doubt that the present species is identical with *S. elliptica* of Reuss, a fossil form which is abundant in some of the Tertiary deposits of Austria. There is a minute agreement between the two in most of the details of structure. The only points in which there may possibly be a slight difference are of secondary importance. Reuss states that there are occa-

* Kirchenpauer records this species from Greenland; but as he identifies it doubtfully with Smitt's *Cellularia scabra*, forma *elongata*, from which it is clearly distinct, I give this locality with reserve.

sionally two or three small depressions on the upper margin of the cell, which, he thinks, may mark the positions of as many spines. Whatever these depressions may be, they seem to be rarely present; and should they denote the occasional development of spines in the living state, this fact could not outweigh the evidence of identity supplied by every leading feature, including the very distinctive form of the vibracular cell. As Reuss's name was published in 1847, it must, of course, supersede Norman's, which only dates from 1866. To the latter we are indebted for the addition of the species to the recent Fauna.

b. *With an operculum.*

SCRUPOCELLARIA SCABRA, Van Beneden.

Plate VI. figs. 7-11.

SERTULARIA HALECINA, *Fabr.* Faun. Grœnl. 443 (*teste* Smitt).

FLUSTRA SCRUPOSA, *Fabr.* Nye Zool. Bidr. in Vid. Selsk. Phys. Skr. 1827-33 (*teste* Smitt).

CELLARINA SCABRA, *Van Ben.* Bull. Acad. Roy. d. Belg. xv. No. 2, 73, figs. 3-6.

CELLULARIA SCRUPEA, *Alder*, Trans. Tynes. Club, iii. 148 (North. Cat. sep. 58).

SCRUPOCELLARIA SCRUPEA, *Busk*, Quart. Journ. Micr. Sc. iii. 254.

SCRUPOCELLARIA DELILII, *Busk*, Quart. Journ. Micr. Sc. vii. 65, pl. xxii. figs. 1-3; *Alder*, Quart. Journ. Micr. Sc. (n. s.) iv. pl. iii. figs. 4-8; North. & Durham Nat.-Hist. Trans. i. 163, pl. viii. figs. 4-8.

CELLULARIA SCABRA, *Smitt*, Kritisk Förteckn., Öfvers. af K. Vet.-Akad. Förhandl. 1867, 283 & 314, pl. xvii. figs. 27-34.

SCRUPOCELLARIA SCABRA, *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 214.

Zoarium slender, dichotomously branched, internodes moderately long (about 5-12 cells in each). *Zoœcia* short, erect, narrowed below; aperture oval, with a smooth border, occupying more than half the front, with one stout spine (or frequently two) on the outer margin above, and a smaller one on the inner. *Oper-*

culum entire, suboval; a portion of the surface slightly hollowed out, forming a depressed area, with a lobate margin. *Lateral avicularia* moderately large, with a slightly hooked beak; a pedunculate avicularium on the lower part of each cell, below the aperture.

Vibracular cells wedge-shaped, stretching transversely across the back of the zoëcium; *vibracula* short, not exceeding the cell in length. *Oœcia* somewhat flattened in front, subglobose, with a smooth subtriangular space above the aperture, from which fine lines radiate towards the margin.

Radical fibres long and slender, and scattered over the whole of the zoarium.

Height about $\frac{1}{2}$ to $\frac{3}{4}$ inch.

HABITAT. On stones, &c., from shallow to deep water.

LOCALITIES. Northumberland coast, from the deep-water boats (Alder): Durham coast (Brady and Hodge): off the Firth of Forth, one specimen (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. North Sea (Van Ben.): Scandinavian and Arctic seas (Smitt): Spitzbergen, 6 fms., and more frequently 80–150 fms. (Swedish Exped.): Davis Straits, off Frederickshaab, 100 fms. (Wallich): Greenland, Godhavn Harbour, Disco, 5–20 fms. ('Valorous' dredg.): Reykjavik Harbour, 15–20 fms. (Wallich): Madeira (J. Y. Johnson).

S. scabra bears a strong general resemblance to *S. scruplea*, but differs from it in several important particulars. The operculum presents commonly a three-sided figure, narrowing off towards the peduncle. It is depressed in the centre, and is not unlike a saddle in shape. It is further distinguished by the hand-like pattern sculptured on its surface. The lateral avicularium is smaller than that of the allied species, and wants its strongly marked beak. On the other hand, the pedunculate avicularia are of larger size, and much more constantly present.

But the most striking difference is found in the vibracular appendage, which in *S. scabra* is of a very remarkable type, and totally unlike the form which prevails throughout this genus. Instead of being erect, with a notch or cleft at the top in which the movable seta works, it lies across the back of the cell, its shape and structure reminding us of the fixed base or beak of a sessile avicularium, while the setiform process is reduced in size and capability of movement, and rather performs the part of a mandible than of the vibraculum, with its free and vigorous swing. We cannot fail to recognize in this modified structure a transition form between the avicularium and vibraculum, which is of the highest morphological interest. In this species the vibracula are commonly wanting on many of the cells.

Amongst the minor characters may be mentioned the short spine which occurs at the top of the median cell at each bifurcation of the branch. The internodes are shorter than those of *S. scrupea*, but still of considerable length. Specimens from Greenland are much stouter and more massive than those from the Northumberland coast; and the species would seem to be specially a northern form, though ranging to Madeira.

SCRUPOCELLARIA SCRUPEA, Busk.

Plate VII. figs. 11-14.

SCRUPOCELLARIA SCRUPEA, *Busk*, *Annals N. H.* ser. 2, vii. 83, pl. ix. figs. 11, 12; *B.M. Cat.* i. 24, pl. xxi. figs. 1, 2; *Heller*, *Bryoz. d. Adriat. M.* 10 (sep.); *Norman*, *Quart. Journ. Micr. Sc.* (n. s.) viii. 214 (3 sep.).

Zoarium erect, the shoots dichotomously divided, internodes much elongated. *Zoæcia* biserial, alternate,

short, ovate above, produced and slightly narrowed below; aperture oval, occupying about half the front, with three spines on the outer margin above, and one, or occasionally two, on the inner. *Operculum* somewhat reniform, entire, narrow and pointed above, expanded below and rounded, the upper extremity elevated. *Lateral avicularia* large and conspicuous, with a strongly hooked beak; small raised avicularia sometimes distributed along the median line, often wanting. *Vibricular cell* erect, somewhat wedge-shaped. *Oœcia* rounded; surface smooth, shining and imperforate. Height $\frac{1}{2}$ to $\frac{3}{4}$ inch.

HABITAT. On Algæ, stones, &c. from shallow and deep water.

LOCALITIES. Off Dartmouth (E. Forbes): Cornwall, off St. Ives, on stones; off Berry Head, Torbay; Salcombe Bay, not uncommon; Guernsey (T. H.): Northumberland, from the deep-water boats, a single specimen (Alder): the Minch (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (M'Andrew): Adriatic (Grube and Heller): Australia (MacGillivray): Singapore (Liverpool Free Museum, *teste* T. H.).

This species has an operculum with a simple, unbranched, and perfectly smooth lamina, and in this respect differs both from *S. reptans* and *S. scabra*, the only other British operculated forms.

The avicularia, which are disposed along the front surface of the zoarium, are very small; and I have only noticed them where the oœcia are present; they are certainly very sparingly developed. They are placed immediately above the ovicells, with the mandible directed alternately towards opposite sides, and probably rise from the front or side of the cell a little below the aperture.

The internodes in this species are remarkable for their length, consisting frequently of as many as 20 cells. The habit is sometimes stout and massive, and the tufts short and compact; but I have a beautiful variety from Guernsey, in which the shoots are more slender and rise to a height of $\frac{3}{4}$ inch.

On the lower segments an immense number of smooth and slender fibres are given off from the vibracular cells, which tend downwards and become adherent.

SCRUPOCELLARIA REPTANS, Linnæus.

Plate VII. figs. 1-7.

CREEPING CORALLINE, *Ellis*, Corall. 37, no. 3, pl. xx. fig. b, B.

SERTULARIA REPTANS, *Linn.* Syst. (ed. 12), 1315.

CELLULARIA REPTANS, *Pall.* Elench. 73: *Reid*, Ann. N. H. Dec. 1845, 385, pl. xii. figs. 1-5: *Johnst. B. Z.* ed. 2, i. 337, pl. lviii. figs. 3, 4: *Dalyell*, Rem. An. i. 235, pl. xlv.: *Smitt*, Kritisk Förteckn. iii. (1867), 284 & 318, pl. xvii. figs. 37-41.

SERTULARIA REPENS, *Berkenhout*, Synops. i. 220 (1789).

CELLARIA REPTANS, *Ell. & Sol.* Zooph. 23: *Lamk.* An. s. Vert. (ed. 2), ii. 191.

SCRUPARIA REPTANS, *Oken*, Lehrb. Naturg. Abth. ii. 90.

CRISIA REPTANS, *Lamx.* Pol. corall. flex. 60.

ACAMARCHIS GÉOFFROYI, *Audouin*, Expl. i. 241: *Savigny*, Egypte, pl. xi. fig. 4.

BICELLARIA REPTANS, *Blainv.* Actinol. 459.

SCRUPOCELLARIA REPTANS, *Gray*, B.M. Cat. Rad. 112.

CANDA REPTANS, *Busk*, B.M. Cat. i. 26, pl. xxi. figs. 3, 4.

Zoarium creeping, branches divided dichotomously into numerous segments, broadly expanded, flabelliform. *Zoæcia* biserial, alternate, ovate, produced and narrowed below; aperture oval, occupying about two thirds of the front, with a somewhat thickened rim, three pointed spines on the outer side at the top and one opposite to them on the inner side; a branched pedunculate operculum rising from the inner margin. *Sessile avicularium* on the outer edge, placed at the very top of the cell, minute, and set back behind the spines; at the

base of many of the cells a large *pedunculate avicularium*, with the mandible directed downwards. *Vibracular cell* somewhat curved, with a constriction about the middle. *Oœcia* subglobose, smooth, with a number of large punctures. *Radical fibres* either simple, and giving off at the extremity a number of anastomosing fibrils forming a netted disk, or toothed.

Polypide with 14–16 tentacles of a light orange colour.

HABITAT. On Algæ, *Flustra foliacea*, rocks, &c., from between tide-marks to deep water.

LOCALITIES. Universally distributed. It may be found on the most barren coasts. It is more especially a littoral form, spreading luxuriantly over various kinds of seaweed; but Mr. Peach records its occurrence on coral taken in 100 fms., from the Outer Haaf, Unst.

GEOGRAPHICAL DISTRIBUTION. Bahusia and Middle Norway, pretty common in the littoral region (Smitt): Heligoland (Kirchenpauer): Red Sea (?) (Savigny): Adriatic, common on Algæ, zoophytes, Polyzoa, &c. (Heller): north coast of France; coast of Spain (Kirchenpauer).

RANGE IN TIME. Scotch Glacial deposits (Geikie).

Mr. Busk has placed this well-known form in the genus *Canda*, Lamx., on the ground that it is destitute of the lateral avicularia, which constitute so striking and distinctive a feature of the allied genus *Scrupocellaria*, Van Ben. Smitt ranks it under his *Cellularia*, which embraces the last-named group, but agrees with Busk in denying the existence of lateral avicularia*. In fact, however, the present species is furnished with these appendages, though they are minute and are not developed on all the cells; and it therefore takes its place of right in the genus *Scrupocellaria*, with which, in all other respects, it entirely

* "Avicularia lateralia externa desunt" (Smitt).

agrees. The smallness of the avicularia, and the fact that they are so placed as to be partially concealed by the spines, may explain their having escaped the notice of such accurate and experienced observers.

In *S. reptans* these lateral appendages are clearly dying out. They are only found on some of the cells, and, as I have said, are generally extremely small, mere pygmies as compared with the similar structures on such a form as *S. scruposa*. They are placed close to the top of the cell, and just behind the triplet of spines. From their reduced size they do not extend down the side of the cell, and are therefore very inconspicuous and liable to be overlooked.

On the other hand, the pedunculate avicularia, placed at the bottom of a certain number of the cells in each internode, are most fully developed, and attain a comparatively gigantic size. We may no doubt trace a connexion between their vigorous condition and the dwindling of the lateral appendages, which must be due to their comparative uselessness, and therefore disuse*.

These large avicularia are situated on the inferior portion of the cell, below the aperture; and though not connected with *every* cell, there is a certain definite and constant number on each internode†. Between the joints

* Smitt has remarked that "on the whole the rule holds good for this genus" (*Cellularia*, including *Scrupocellaria*), "that the more the lateral avicularia are developed, the less are the anterior" (Kritisk Förteckn. part iii. p. 305, footnote), a remark which I can fully confirm; and I believe that the converse is also true. We have a remarkable illustration in *S. ferox*, Busk, a species from Bass's Strait, which possesses a very large pedunculate avicularium, occupying almost the whole front of the cell below the aperture, with a long curved mandible, whilst its lateral avicularia are rudimentary and quite insignificant. The relative development of the two classes of avicularia is much the same in *S. diadema*, Busk.

† Busk speaks of the front avicularia in this genus as "disposed in a special tract along the middle of the branch or internode." This is the case in his *C. arachnoides*, which also wants the lateral avicularia; and to this species the name *Canda* must be restricted; his remark does not apply to *S. reptans*.

there are always, as far as I have seen, seven or five cells; on the larger internode there are three pedunculate avicularia, on the smaller two. The peduncle on which these appendages are mounted is much elevated; it is swollen at the base, and higher in front than behind, so that the avicularium is tilted up, its strongly curved beak being directed outwards.

The operculum, which in its earliest stage of growth is simple and entire, becomes dichotomously branched, and spreads out like an antler over the entire aperture, which it completely protects.

The radical fibres are present under two forms, and enable the species to adapt itself to very different habitats. In one they are simple tubes, originating, as all similar appendages do in this group, at the base of the vibracular cell; and from the free extremity a number of fibrils are given off, which branch and anastomose and form circular reticulated disks, by which the polyzoon is firmly attached to the surface of the rock or the frond of the sea-weed. These disks may remind us of the rootlets by which the ivy clings to its support. The tubes are not merely produced towards the base of the zoarium, but along the course of the branches, which, as they increase in length, are firmly attached at intervals; and in this way the polyzoon creeps, like a plant, over the surface on which it grows. But a modification of the merely adherent appendage is also met with; and it would seem that the particular form which the radical fibre assumes is very much determined by the nature of the base on which the polyzoon is developed. In its second form, the fibre is covered for about two thirds of its length with sharp, recurved, hook-like processes, and is converted into an admirable prehensile organ. It is a veritable grapnel, which is plunged into the soft sar-

code of the sponge, or other yielding substance, and holds the polyzoon, like an anchor, to its place*.

Dredging on one occasion in Salcombe Bay, I took up a piece of some cotton material which was overgrown by *S. reptans*. On the uneven fibrous surface the adhesive disks would have been almost useless; a few of them only were developed; but the toothed processes were present in profusion, and had worked their way in amongst the threads of the fabric, which had become entangled amongst the hooks, and so anchored the tufts securely. On a specimen beside me, growing on the flat surface of a *Laminaria*-frond, I cannot find a single grapnel; but the disks are finely developed, and of large size.

S. reptans grows in somewhat circular tufts, the branches spreading out on all sides, and being more or less decumbent.

This fine species is one of the most highly specialized

* This interesting piece of structure did not escape the "lyncean" Ellis. He says:—"Some of these little radical tubes are discovered by the microscope to be full of hooks, the better to secure the Coralline when it adheres to soft spongy substances" (Corall. p. 38). He also figures one of these modified fibres.

Couch has also briefly noticed the occurrence of hooked fibres on the present species (Cornish Faun. pt. iii. p. 127). But we are indebted to Mr. Peach for the most detailed observations on this interesting point. He describes very graphically the grapnels of *S. scruposa*, "the stout hooked spines" of which were buried in the sponge. These hooks "are shaped like the thorn of a rose-tree, and surround the 'root-fibres';" and when dragged out they hold in their grasp numbers of the sponge-spicules." He also met with similar appendages on *S. reptans* when growing upon sponge. A specimen developed on *Flustra foliacea* was altogether destitute of the hooks, the fibres terminating in a number of short and simple "radiating processes," by which they adhered. From these processes "short disk-like pieces" are given off, which are inserted into the opening of the cell of the *Flustra*; and in this way a firmer grip is secured. There appears in this case to be another slight adaptive modification determined by the habitat. On the smooth and solid surface of the *Laminaria* the terminal fibrils are much more branched, so as to give a larger adhesive surface to the disk. Mr. Peach's papers are published in the Linnean Society's Journal, Zool. vol. xiii. p. 479, pl. xxiii. and the Journal Roy. Inst. Cornwall. 1877, No. 19.

of the Cheilostomata and presents, as it were, an epitome of the structural characteristics of the tribe. As it is to be found everywhere, the student of the Polyzoa can select no better form to work upon, so far at least as external structure is concerned.

Genus CABEREA, *Lamouroux*.

Der. From *Caberea*, daughter of Proteus.

CABEREA, Lamx. (1816), Pol. corall. flex. : Busk : Smitt.

CELLARIA (sp.), Lamarck.

FLUSTRA (sp.), Flem. : Johnst.

CELLULARIA (sp.), id. : id.

CRISIA (sp.), Audouin.

SELBIA, Gray, Dieffenbach's New Zealand, ii.

FLABELLARIA, Gray, B.M. Rad. 106.

CANDA (sp.), D'Orb. Pal. Franç.

GENERIC CHARACTER. — ZOARIUM *not articulated*. ZOÆCIA *in two or more series, subquadrangular or ovate, with a very large aperture*. SESSILE AVICULARIA *on the side and front of the cells, the lateral avicularium minute*. VIBRACULAR CELLS *very large, placed in two rows, stretching obliquely downwards across the back of the zoæcia, which they almost cover, to the median line, notched above and traversed through a great portion of their length by a shallow groove*. SETÆ *usually toothed on one side*.

IN *Caberea* the zoæcia have a tendency to assume a somewhat quadrate form, and the aperture occupies a very large proportion of the front surface. The arrangement of the avicularia is much the same as in *Scrupocellaria*; but the lateral avicularium is very inconspicuous, and may readily escape notice. The striking feature of the genus is the enormous development of the vibracula, which almost cover the back of the zoarium, and give it a very marked and peculiar appearance. From the upper and outer angle

of the cell they stretch diagonally downwards, reaching to the median line, where the two opposite rows meet. The vibracular cell is of an elongate-oval figure above; and this portion of it bears some resemblance to a delicate bivalve shell resting on its dorsal surface, and slightly gaping. Below it is much produced and attenuated. At its upper extremity there is a cleft in which the movable *seta* works; and when at rest it lies in the groove, which passes from the terminal notch downwards.

The size of the vibracula in the genus *Caberea* is not their only peculiarity. In *C. Boryi* (and probably in the other species) they differ from the same appendages in the kindred genera physiologically as well as in form and size. Whilst the vibracula of *Scrupocellaria* act independently of one another, those of *C. Boryi* move together with perfect regularity; they act not individually, but in companies, obedient to a common impulse. After a short interval of quietude all the vibracula on a shoot are seen to start into sudden activity, swinging themselves round simultaneously to the front of the cells, and then sweeping backwards again and resuming their former position. After another interval the same synchronous and perfectly regular movement takes place, and so on continually. There is something positively startling, after the absolute quiet, in the sudden simultaneous rush of the whole host of vibracula into energetic action *.

In this species, then, not only are the individual appendages highly developed, but the whole company of them attached to a colony are brought into combined and harmonized action. It must be left to future observation to determine the precise structural conditions on which these

* See a paper by the author, "On the Movements of the *Vibracula* in *Caberea Boryi*" &c., in the Quart. Journ. Micr. Sci. for Jan. 1878.

remarkable movements depend ; but they certainly seem to imply the existence of a nervous system distinct from that of the individual polypides, by which the vibracular zooids are controlled and brought into relation.

The *Cabereæ* constitute a small group, of which one (*C. Boryi*) is almost cosmopolitan ; another (*C. Ellisii*) is an Arctic species, which ranges to the more northerly portions of our coasts, on the one hand, and to Labrador and Maine, on the other ; and the remainder inhabit the Australasian seas.

CABEREA ELLISII, Fleming.

Plate VIII, figs. 6-8.

FLUSTRA ELLISII, *Flem. Mem. Wern. Soc.* ii. 251, pl. xvii. figs. 1-3.

FLUSTRA SETACEA, *Flem. B. A.* 536 : *Johnston*, B. Z. ed. 2, 346.

CELLULARIA HOOKERI, *Johnston*, B. Z. (ed. 2), 338, pl. lx. figs. 1, 2.

BICELLARIA HOOKERI, *Blainville*, Dict. Sc. N. lx. 424.

CABEREA HOOKERI, *Busk*, B.M. Cat. i. 39, pl. xxxvii. fig. 2 : *Gosse*, Mar. Zool. ii. 14, fig. 20.

FLABELLARIA SETACEA, *Gray*, B.M. Cat. Rad. 106.

CABEREA ELLISII, *Hincks*, Devon & Cornw. Cat. 63 : *Smitt*, *Œfvers. K. Vet. Akad. Förhandl.* 1867, 287 & 327, pl. xvii. figs. 55, 56 : *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 217.

Zoarium fan-shaped, of a yellowish-brown colour, dichotomously branched, branches thick, widening upwards. *Zoecia* in 2-4 rows, short, subquadrangular ; aperture elliptical, occupying nearly the whole of the front, with a broad, minutely granulated margin, sloping outwards ; marginal cells with two stout spines above on the outer side and one on the inner ; central cells with one on each side. *Lateral avicularia* small and inconspicuous, placed a little below the top of the cell, with a rounded mandible ; *anterior avicularia* raised, two below the aperture, placed one at each side, or sometimes only one ; mandible rounded, directed downwards. *Vibracula* very long, serrate. *Oæcia* flattened, frequently with a depressed, smooth, semi-

circular space in front, from which fine striæ radiate to the margin.

Height about 1 inch.

HABITAT. Deep water.

LOCALITIES. Shetland, deep water (Flem.): Orkneys (Barlee): the Minch; Shetland, 40–70 fms., abundant (A. M. N.): off the coast of Antrim, 62–72 fms. (Mr. W. Swanston), the most southern recorded locality on our coasts.

GEOGRAPHICAL DISTRIBUTION. Labrador and Maine (Packard): St. George's Banks, 28 and 150 fms. (Smith and Harger): Greenland, 100 fms.; Reykjavik Harbour, 15–20 fms. (Wallich): Scandinavia and Finmark, 50–80 fms., not uncommon (Smitt): Roscoff, rather rare, in large tufts on fragments of *Eschara* (Joliet).

RANGE IN TIME. Scotch Glacial deposits (Geikie): Palæolithic (A. Bell).

The cells in this remarkable form are peculiarly shaped; they are short, somewhat four-cornered, almost entirely open in front, and present, as Smitt has pointed out, a very Membraniporidan appearance. The branches are convex, rising considerably towards the centre. They consist towards the lower part of two rows of cells; but this number increases to three or even four rows, so that the branches widen upwards.

The lateral avicularia are very small, and may readily escape detection. They are placed just at the base of the lowest of the spines on the outer margin, and extend for some distance down the side of the cell, but project very slightly. We do not find the rounded mandible, which belongs to this species and to *C. Boryi*, in any of the allied genera.

The vibracular cell is of great size, somewhat fusiform, with a smooth and polished surface, and of very delicate texture. The groove occupies about two thirds of its

length, and opens below into a deep channelled space, inclosed at each side by a prolongation of the cell-walls, which tapers off downwards and is carried along the median line until it reaches the wall of the next vibracular cell. Owing to this arrangement of the vibracula, a very large proportion of the dorsal surface of the zoarium is covered by them.

A striking feature of the present species is the remarkable development of the radical fibres, and the mode in which they are disposed. They take their origin on the side of the vibracular cells, and are given off from the upper as well as from the lower portion of the branches. Passing off from the vibracula on each side of the zoarium, the tubes tend downwards along the median line of the dorsal surface, one superimposed upon the other, and all closely adherent, so as to form in the adult colony a prominent keel-like projection along the back of the branches. As growth proceeds and new cells are formed fresh strands are added to the fibrous bundle, which is, of course, smallest above. Below each bifurcation the bundles join and blend, while at the base of the zoarium the multitudinous threads become free and form so many separate cables by which the polyzoon is anchored in its place.

All the fibres are carried down the centre of the dorsal surface, and neatly piled up along the median line; so that there is no interference with the action of the vibracula.

CABEREA BORYI, Audouin.

Plate VIII, figs. 9-11.

CRISIA BORYI, *Audouin*, Expl.: *Savigny*, Egypte, pl. xii. fig. 4.

CELLULARIA HOOKERI, *Fleming*, B. A. 539.

SELBIA ZELANICA, *Gray*, *Dieffenbach's New Zeal.* ii. 292.

CABEREA ZELANICA, *Busk*, *Voy. 'Rattlesnake,'* i. 378.

CANDA BORYI, *D'Orb. Pal. Franç. T. Crét. v. 331.*

CABEREA BORYI, *Busk, B.M. Cat. i. 38, pl. xvi. figs. 4, 5 (as C. zelanica), and pl. xxxviii. (as C. patagonica): Hincks, Ann. N. H. for Feb. 1855 (3 sep.): Heller, Bryoz. d. Adriat. Meeres, 13: Norman, Quart. Journ. Micr. Sc. (n. s.) viii. 217.*

Zoarium forming small flabellate tufts; branches stout, divided dichotomously into a few segments. *Zoæcia* in two rows, or occasionally three, short, ovate, very slightly produced and narrowed below; aperture oval, with a flattened, rather broad border, expanded at the bottom; two or three spines on the outer side above, and one on the inner, springing from the peduncle of the operculum; operculum expanded downwards, and filling in the lower part of the aperture, occasionally giving off a pointed process above; or more regularly developed and suboval. *Lateral avicularia* very small; mandible rounded. *Anterior avicularia* raised, placed between the cells down the median line, sometimes very large; mandible rounded. *Vibracula* broad and flat below, slender and tapering above, serrate. *Oæcia* arcuate, smooth, inclined inwards.

Height about $\frac{1}{8}$ inch.

RANGE OF VARIATION. On Australian specimens I have met with three spines on the outer side of the cells, instead of the two which characterize such British examples as I have examined. The Australian form, too, is distinguished by the very large size attained by the central avicularia. They are raised, swollen, well rounded above, and have the mandible on the front, perpendicular to the surface of the zoarium. They form a line down the centre of the branch. In British specimens they are much smaller. The lateral avicularia are extremely inconspicuous. The operculum exhibits some curious differences in the mode of its development. Sometimes it expands altogether *downwards*, filling in the lower part of the aperture, and appearing as if soldered to the margin. Occasionally a short spur is given off above. In other

cases it takes the regular course, and assumes the ordinary form, being pretty equally developed above and below. In the size of the tufts the Australian and British forms agree.

HABITAT. On *Eschara* and other Polyzoa, Nullipores, Algæ, &c., from between tide-marks to moderately deep water (Coralline ground).

LOCALITIES. Torquay (Hooker) : on *Eschara foliacea* and *Scrupocellaria scruposa*, off Budleigh-Salterton (Miss Cutler and T. H.) : Goran Haven, Cornwall (C. W. P.) : ? Ilfracombe (A. Leipner)* : Guernsey, common (R. S. Cooper and A. M. N.) : Herm, tidemarks, under stones (T. H.) : Jersey (A. M. N.) : Hastings, rare (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Egypt (Savigny) : Adriatic, on Nullipores (Heller) : New Zealand (Hooker and F. W. Hutton) : Glenelg, Australia (T. H.) : Cumberland Island (Busk) : E. Falkland Islands ; S. Patagonia, 49° S. ; Port St. Julian, Patagonia ; Strait of Magellan (Darwin) : Algoa Bay (Busk) : Singapore (Liverpool Free Museum, *teste* T. H.) : Roscoff, common (Joliet).

The vibracular cells of this species bear a close resemblance to those of *C. Ellisii*. The radical fibres originate only on the lower portion of the zoarium, hardly extending much beyond the base of the shoots ; and the dorsal surface therefore wants the prominent subcarinate appearance which it exhibits in the latter species.

Both in this and the preceding species the older portions of the zoarium become coarse and much thickened ; and in this condition it is very difficult to determine the minute structure.

C. Boryi does not occur in the extreme north, but otherwise is remarkable for the extent of its geographical range.

* Mr. Leipner has a fine specimen, which he has no doubt was obtained either at Ilfracombe or Tenby—he believes, the former.

Family IV.—Bicellariidæ.

BICELLARIADÆ, Busk.

BICELLARIIDÆ, Smitt.

ZOÆCIA rather loosely united in two or more series, or disjunct; obconic, or boat-shaped, the aperture usually occupying a large proportion of the front. AVICULARIA, when present, capitate, pedunculate, and jointed. ZOARIUM not articulated, erect, and phytoid, or composed of a number of cells connected by tubular processes.

THE zoarium assumes two very different and strongly contrasted conditions within the limits of this family; and it is only after carefully examining the entire series of forms included in it that we recognize the close affinity of such divergent genera as *Bicellaria* and *Beania*.

The two are connected and linked together by the genus *Bugula* and the genus *Diachoris*, of which latter we have no representative on our coasts, but which occurs in the Mediterranean.

In *Bicellaria* the cells are widest above, and taper off very decidedly below. The inferior subtubular portion is generally much produced, and occupies a much larger proportion of the whole than it does in the genus *Bugula*. The aperture is usually ample, though not so large as in the last named; it narrows downwards, and is slightly pointed below (woodcut, fig. 1). The cells are so placed that the lower extremity is directed inwards towards the median line; and this is also the case, though to a less extent, in the genus *Bugula*.

Fig. 1.

*Bicellaria* (Australian).

In the latter the tubular portion of the cell towards the base is reduced in length, and the aperture occupies fully two thirds of the front; occasionally (as in *B. umbella*, Smitt) it extends to the bottom.

These two genera are united through the species of *Bicellaria* in which the aperture encroaches most upon the tubular base of the cell, and the species of *Bugula* in which it is most contracted.

In such forms as *B. Murrayana*, with its elongate, boat-shaped cell, open in front through a great portion of its length, and margined with spines (woodcut, fig. 2), or *B. umbella*, with aperture actually extending to the base, we have a near approach to the form of *Diachoris*, which may be described popularly as a *Bugula* with its cells disjoined and held in connexion by a number of tubular processes, and assuming a

Fig. 2.

*Bugula Murrayana.*

decumbent instead of an erect habit of growth. These two genera also agree in having capitate avicularia of much the same type, and occupying similar positions in the zoarium. It is only in this family that we meet with the capitate and jointed avicularium—the true “bird’s head,” with its elaborate structure and curious movements, the most highly specialized form which the organ assumes. In *Beania* we have a form closely allied to both *Bugula* and *Diachoris*. The latter is distinguished from it by the more complex character of its zoarium, and by the presence of avicularia. There is little difference in the habit of growth; for in some species of *Diachoris* the cells are semi-*Diachoris spinigera*.

Fig. 3.



erect. The zoœcia are essentially identical in character; and such a species as *D. spinigera*, Mac-Gillivray (woodcut, fig. 3), in a young state, when the cells are ranged in a single line, is hardly distinguishable from a *Beania* (woodcut, fig. 4).

Throughout this family the cells are loosely connected; in *Bicellaria*, though placed side by side, they are often really disjunct.

In some of the *Bugulæ* (e. g. *B. Mur-rayana*) the branches are composed of many rows of cells, and assume a somewhat Flustrine appearance; whilst such forms as *Bicellaria Alderi* remind us of the *Cellulariidae*.

Fig. 4.

*Beania mirabilis.*

Genus BICELLARIA, *Blainville*.

Der. From *bis*, twice, and *cella*, a cell.

BICELLARIA, Blainville, Dict. Sc. Nat. 1830: Gray: Busk, &c.

CELLULARIA, Pallas (part.): Fleming: Johnston: D'Orbigny.

CELLARIA (part.), Ell. & Sol.: Lamk.

CRISIA (part.), Lamouroux: Van Beneden.

GENERIC CHARACTER.—ZOARIUM *erect, phytoid*. ZOËCIA *turbinate, or in the form of a cornucopia, loosely united, more or less free above; aperture looking more or less upward, directed obliquely inwards below; inferior portion of the cells subtubular, usually much produced*. AVICULARIA, *when present, jointed and capitate**. No vibracula.

IN *Bicellaria* the zoarium does not present the variety of structures which we have in *Menipea* or *Scrupocellaria*;

* An exception is presented by the Australian *B. tuba*, which possesses a fixed avicularium, borne at the top of a tall spinous process.

but it is distinguished by grace, delicacy, and picturesqueness, the latter being chiefly due to the great development of spines, which is a feature of the genus, and to the peculiar turn of its cells in most of the species. The aperture varies in the proportion which it bears to the length of the cell, and the degree in which it is turned inwards. Occasionally it is subterminal, and looks upwards much more decidedly than is usual. In one or two Australian species it is elongated, and very much bent inwards towards the median line. In our own *B. Alderi*, while there is the same general form, the cells are much straighter, and the arrangement is more compact and regular, reminding us, as I have already remarked, of the *Cellulariidae*.

The spines are profusely developed in this group, and occur not only on the margin of the aperture, but also on the dorsal surface. The avicularia, when present, are but sparingly developed; and in some species they are altogether wanting. In this respect *Bicellaria* offers a contrast to *Bugula*, which is remarkable for the profusion of these appendages as well as for their highly specialized form.

As in *Caberea*, there is in some of the species a wonderful development of the radical fibres. In the exquisite Australian form, *B. tuba*, Busk, which grows in feathery tufts of considerable size, they extend along the back of the shoots for about two thirds of their height, forming a compact mass of white, glistening tubes. Each tube originates on the back of a cell, and, so far as I have observed, of those particular cells only which are placed between the diverging branches at a bifurcation. From these points or stations the fibres tend downwards, uniting as they proceed with the bundle already formed below them, which at the base resolves itself into a multitude of separate rootlets.

All the known species of *Bicellaria*, with the exception of the two that occur in Britain, are natives of the Australian seas.

BICELLARIA CILIATA, Linnæus.

Plate VIII. figs. 1-5.

CILIATED CORALLINE, *Ell.* Corall. 38, no. 5, pl. 20, figs. *d.* D.

SERTULARIA CILIATA, *Linn.* Syst. ed. 10, 815, ed. 12, 1316.

CELLULARIA CILIATA, *Pall.* Elench. 74: *Flem.* B. A. 540: *Johnst.* B. Z. ed. 2, 335, pl. lvii. figs. 1, 2: *Dalyell*, Rem. An. Scotl. i. 239, pl. xlvii.: *D'Orbigny*, Pal. Franç. Terr. Crét. v. 49.

CELLARIA CILIATA, *Ell.* & *Sol.* Zooph. 24: *Lamk.* An. s. Vert. ed. 2, ii. 186.

BUGULA CILIATA, *Oken*, Lehrb. Naturg. 89.

CRISIA CILIATA, *Lamx.* Pol. cor. flex. 60: *Van Ben.* Recherches, 51, pl. vi. figs. 9-11.

BICELLARIA CILIATA, *Blainv.* Actinol. 459, pl. lxxviii. fig. 2: *Busk*, B.M. Cat. i. 41, pl. xxxiv.: *Smitt*, Cefvers. K. Vet. Akad. Förhandl. 1867, 288 & 333, pl. xviii. figs. 1-3.

Zoarium of a pearly-white colour, forming delicate feathery tufts; dichotomously branched, branches curved inwards at the extremities. *Zoæcia* alternate, turbinate, enlarged above, and narrowing off rather abruptly towards the bottom, the inferior portion cylindrical, everted and free at the top; aperture elliptical, oblique; 4-7 very long, slender, incurved spines on the upper margin, and one placed centrally immediately below the aperture; one or two spines on the dorsal surface. *Avicularia* situated on the outer side of the cell, a little below the aperture, small, with a serrate beak. *Oæcia* pedunculate, helmet-shaped, attached to the inner side of the cell.

Polypide with 12-16 tentacles. *Primary cell* jointed at the base to a short process from the radical fibre, widening upwards, elongate; aperture terminal, suboval, very slightly oblique, with about 11 spines (woodcut, fig. 5).

Height commonly about $\frac{1}{2}$ inch.

Fig. 5.



HABITAT. On Algæ and zoophytes (especially), and on stones, shells, &c., from between tide-marks to moderately deep water.

LOCALITIES. Cornwall, on corallines and sponges; near the Eddystone, not common; Mount's Bay (Couch): South Devon, on Sertularian hydroids &c., common; Ilfracombe, rock-pools and dredged in 8-10 fathoms; Filey, on zoophytes and under stones; Fleetwood, on a buoy; Menai Straits; Swanage Bay (T. H.): Tenby (F. Walker): Hastings (Miss Jelly): Northumberland, rare (Alder): south coast of Durham (J. Hogg): St. Andrews, frequent from the Coralline ground (Dr. M'Intosh): Ayrshire, rare (Landsb.): Peterhead and Wick, rare; Durness, Sutherlandshire (C. W. P.): Shetland, 45 fathoms, haddock-ground, Out Skerries, very rare (A. M. N.): coasts of Ireland, sparingly (W. Thompson).

GEOGRAPHICAL DISTRIBUTION. Ostend (Van Ben.): La Rochelle, Gironde (Fischer): Roscoff (Joliet): Bay of Gullmaren, Bahusia (Lovén and Lilljeborg): Heligoland, 5-6 fathoms; N. America (Kirchenpauer): South Africa, var.* (T. H.).

The enormous development of the spines is the most striking feature of this attractive species. Those on the upper margin, which are of great length, curve inwards over the higher part of the cell, while the solitary one† below is directed upwards, so that the polypide is completely embowered, and, no doubt, is largely benefited by

* In the South-African form the cells are much shorter than in the British; the portion below the joint is much less elongated, and the cells are therefore more closely packed together. The avicularium is of larger size; and the inferior spine, so far as I have seen, is always more or less lateral. The habit seems also to be stiffer. These slight differences have an interest as showing by what almost imperceptible degrees forms are modified and change their aspect.

† There are occasionally two at the bottom of the aperture.

the friendly shelter. There is usually one dorsal spine placed on the inner side, a little behind the margin ; and sometimes a second is present. Just at the point where the narrow, cylindrical portion of the cell commences, there is a kind of joint. The ovicell does not rise from the margin, but from the side of the cell a little below it, and is distinctly pedunculate. Its opening is turned towards the aperture, which it overhangs*.

The avicularium presents no very marked feature, if we except the serrate beak. It is rounded behind, but not arched above, the upper surface being remarkably straight ; the beak is short, and scarcely hooked at the point.

The shoots rise from a bundle of fibres which are carried up for a short distance upon the surface, involving the cells near the base.

No description or drawing, I may add, can give an adequate idea of the beauty of this species, or do more than suggest the charm which lies in its exquisitely soft feathery tufts, its transparent whiteness, and its graceful habit.

BICELLARIA ALDERI, Busk.

Plate IX. figs. 3-7.

- BICELLARIA ALDERI, *Busk*, Rep. B. Assoc. 1859, Trans. Sect. 145 ; Quart. Journ. Micr. Sc. 1860, 143, pl. xxviii. figs. 1-3: *Smitt*, Cefvers. K. Vet. Akad. Förhandl. 1867, 289 and 335, pl. xviii. figs. 4-8: *Norman*, Quart. Journ. Micr. Sc. viii. 218.
- BICELLARIA UNISPINOSA, *Sars*, N. Mag. f. Naturv. B. xii. 286 ; Geol. og Zool. Iagttagelser &c. (1863) 34.

Zoarium white and transparent, dichotomously branched.

Zoæcia in two series, alternate, very loosely connected

* The structure of the oœcium has been admirably demonstrated by Nitsche in a paper "On the Developmental History of certain Cheilostomatous Bryozoa," Zeitschr. f. wissenschaft. Zool. Band xx. Heft 1, pp. 3, 4.

laterally, often disjunct, turbinate, much produced and attenuated downwards; dorsal surface smooth and entire; aperture broad above, with a somewhat straight upper margin, narrowed below, occupying usually less than half the length of the cell, bearing a single, very long, curved spine on its outer angle. *Avicularia* capitate, much swollen, placed on the side of the cells at the lower extremity, with the mandible directed outwards. *Oæcia* superior, subglobose; surface entire, polished, marked with fine radiating striæ.

Polypide with 16 to 18 tentacles. *Primary cell* small, very slender and cylindrical below, with an elliptical aperture bearing on its margin six outspread spines.

HABITAT. On hydroids (especially), *Gorgoniæ*, small stones, and shells from deep water.

LOCALITIES. Shetland (Barlee) : 5 to 7 miles east of the island of Balta in 40–70 fathoms on soft ground; off Unst and Out Skerries, in 40–100 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Æsterraat, Norway, attached to small stones and shells in 80–100 fathoms (M. Sars) : off the coast of Norway in 200 fathoms (Baron Uggle) : the Bömmel-Fjord, 106 fathoms (Kirchenpauer).

In this delicate and graceful species the two lines of cells which compose the shoots are not welded together so as to form one solid piece, but rather run side by side united at certain points and more or less separated through a great portion of their length. They are very loosely connected, and at the extremity of the shoots are usually altogether disjunct. The condition of the zoarium in this respect marks the transition from the simply uniserial forms to those in which the series of cells are more thoroughly connate, such as *Cellularia*, &c. In the present species the shoots commence with a few single cells, which rise one from the other, each taking its origin above the angle which is

opposite to the one bearing the spine. In this condition they bear a general resemblance to *Eucratea*. This simple growth, however, soon ceases; after a while, from the uppermost in a series *two* cells are given off, the second taking its origin from the side a little below the angle. From these two cells two series are developed, which become more or less adnate, though never completely or very intimately united. The second line of cells may be compared to a branch, in such a form as *Scruparia clavata*, which (as sometimes happens in the latter) is closely appressed to the original shoot, and to a certain extent unites with it.

In *B. Alderi* the branching is simply dichotomous. At certain intervals the terminal zoœcia give off a *pair of cells* instead of one; and each pair becomes the first term of a new series. The branches, turned outwards by the two interposed cells*, diverge, forming at the point of divergence an acute angle. So loosely, however, are the lines of cells connected, that above the fork they may sometimes be met with not even side by side, but perfectly free and independent.

Towards the base the shoots are involved in a bundle of tubular fibres, by which the colony is attached; the fibres pass upwards for some distance along the dorsal surface of the cells, to which they are closely adnate.

The spines on the projecting outer angle of the aperture are a striking feature in the present species. There is usually only one to a cell; but two are sometimes present, placed side by side. They are often of great length, two or three times as long as the cell; they are gracefully curved, and taper slightly towards the extremity.

* The aperture of these cells is always elliptical, whereas that of the others is broad and somewhat truncate above, projecting considerably at the outer angle, and becomes narrow towards the bottom.

The avicularia, judging from the descriptions of the elder Sars (to whom we are indebted for a detailed and most admirable account of the species) and Smitt, must be plentifully developed in Scandinavian specimens; but they are not mentioned by Busk; and in none of the British examples which I have examined (a considerable number) have I found any trace of them, except in a single instance. They are shaped like a bird's head, short, and much swollen behind, and are destitute of the teeth on the rostrum which occur in *B. ciliata*. The ovicells are semicircular in form, somewhat flattened, and prettily lineated in front, and, according to Norman's comparison, closely resemble the flower of the *Calceolaria*.

Genus BUGULA, Oken.

BUGULA, Oken, *Lehrb. Nat.* 1815: Busk: Smitt.

ACAMARCHIS, Lamx. 1816.

CRISIA (sp.), Lamx.

CELLULARIA (sp.), Pallas: Johnston.

CELLARIA (sp.), Lamarck.

AVICELLA (sp.), Van Beneden.

AVICULARIA (sp.), J. V. Thompson, MS. Brit. Mus.: Gray.

BUGULINA (sp.), Gray, B.M. Radiata.

CRISULARIA (sp.), Gray, *ibid.*

FLABELLARIA (sp.), Gray, *ibid.*

ORNITHOPORA (for *B. avicularia*), D'Orbigny, Pal. Franç.

ORNITHOPORINA (sp.), D'Orbigny.

GENERIC CHARACTER.—ZOARIUM erect, *phytoid*. ZOÆCIA boat-shaped, or subquadrangular, elongate, united in two or more series; aperture occupying a large proportion (occasionally the whole) of the front, not turned upwards or oblique. AVICULARIA in the form of a bird's head, pedunculate and jointed, usually one on each cell.

WE have a modification of the cell in the present genus

by which it is distinctly separated from the preceding, and which marks it out as a very natural group. The turbinate cell, with the more or less upturned and up-looking aperture, somewhat abruptly bent inwards below towards the median line, which is characteristic of the more typical *Bicellariæ*, gives place in *Bugula* to an elongate, boat-shaped cell, slightly attenuated towards the bottom, and often truncate at the top, the front of which is usually occupied for three fourths of its length or more by the aperture. The latter stretches vertically from the top of the cell downwards; it is not set obliquely, looking upwards; nor is it so decidedly bent in towards the median line at its lower extremity as in *Bicellaria*, although, from the peculiar turn of the cells, it is somewhat inclined inwards below. The spines have ceased to be so conspicuous a feature, though still present. The cells are more closely united than in *Bicellaria*; but the structure is far from solid or compact. The avicularia are developed in great abundance, and often attain a large size. In most cases every cell is provided with one, articulated to its outer side; and in the living specimen the surface of the zoarium exhibits a strange and animated scene as the multitude of grotesque heads sway themselves to and fro, and snap their tiny jaws, as it seems, with aimless energy.

In this genus the polypide exhibits a somewhat strongly marked structural character. The tentacular corona is only just protruded beyond the orifice of the cell; the pharynx is wide and ample, while, on the other hand, the œsophagus is reduced in size and extremely short. At the bottom of it there is a distinct cardiac valve, and below this a subglobular chamber which opens into the true stomach. The walls of this chamber, as well as of the stomach, are richly coloured by the hepatic glands, which are highly developed. A prolongation of the diges-

tive sac above supports the pyloric valve; and beyond this the intestine dilates into a large oval cavity, extending to the point of exit at the base of the tentacles.

Altogether the alimentary canal presents a rather characteristic form; while the general appearance of the polypide is affected by the rudimentary condition of the œsophagus.

The *Bugulæ* are not unfrequently brightly coloured. They are very widely distributed; and in *B. neritina* (the type of the genus as constituted by Oken) they have a cosmopolitan representative, which is to be met with in most seas*.

BUGULA AVICULARIA, Linnæus.

Plate X. figs. 1-4.

BIRD'S-HEAD CORALLINE, *Ellis*, Corall. 36, No. 2. pl. xx. figs. a A.

SERTULARIA AVICULARIA, *Linn.* Syst. ed. 10, 809.

CELLARIA AVICULARIA, *Ell. & Sol.* Zooph. 22 : *Lamk.* An. s. Vert. ed. 2, ii. 191.

BUGULA AVICULARIA, *Oken*, Lehrb. Naturg. 90 : *Busk*, B.M. Cat. i. 45, pl. liii. : *Alder*, North. Cat. 59 (sep.) : forma 1, *Smitt*, Cefvers. K. Vet. Akad. Förhandl. 1867, 289 & 339, pl. xviii. figs. 9, 10, 12-15.

CRISIA AVICULARIA, *Lamx.* Pol. corall. flex. 141.

CELLULARIA AVICULARIA, *Johnst.* B. Z. ed. 2, 338, pl. lxiii. figs. 7, 8 : *Landsb.* Pop. Hist. 341, pl. xix. fig. 72.

CELLULARIA AVICULARIS, *Reid*, Ann. N. H. ser. 1, xvi. 389 : *Dalyell*, Rem. An. Scotl. i. 241, pls. xlviii., xlix.

ORNITHOPORA AVICULARIA, *D'Orbigny*, Pal. Franç. Terr. Crét. v. 322 †.

Zoarium bushy; branches flabellate, divided dichoto-

* "*Acamarchis neritina*, qui paraît maintenant habiter le monde entier, se fixe à la quille des navires et se fait transporter partout" (*D'Orbigny*, 'Voyage dans l'Amérique méridionale,' t. v. 4^{me} partie, Zoophytes, fig. 10).

† I do not give *Avicella avicularoides*, *Van Ben.*, as a synonym. He describes the avicularia of his species as having mandibles "*courtes et ramassées*," terms which are not applicable to those of the present form. The

mously into narrow linear segments, disposed spirally round the stem. *Zoæcia* biserial, elongate, narrowed below, elevated towards the oral end; aperture occupying more than three fourths of the front of the cell, obovate; margin thin, with two spines above on the outer side and one on the inner. *Avicularia* large, compressed laterally, with a much elongated and slightly bent beak, placed on the outer edge of the aperture about halfway down the cell. *Oæcia* subglobular, prominent, free, hyaline and smooth.

Polypide with 14 to 15 tentacles.

HABITAT. On shells, zoophytes, *Flustra foliacea* (especially), &c., between tide-marks, and from moderately deep water (20–50 fathoms).

LOCALITIES. The Minch, Hebrides; Shetland, not common (A. M. N.): Peterhead and Wick, on *Flustra foliacea*, &c., from deep water (C. W. P.): Coralline ground on *Flustra foliacea* (Dr. M'Intosh): Northumberland, from deep water, occasionally (Alder): Hastings (Mr. Tumanowicz): South Devon, not common (T. H.): Cornwall, on the Corwich Crab, Megavissey Bay and Mount's Bay, not common (Couch).

GEOGRAPHICAL DISTRIBUTION. Spitzbergen, Sørje Bay, 40–50 fathoms (mud bottom), rare; most northern part of Spitzbergen, on *Cellularia* and *Flustra*, 20–50 fathoms (Smitt): Adriatic (Heller): Hobson's Bay, Australia (MacGillivray).

This is a smaller and less striking species than the following, and apparently less common. It is of slender

aperture is also said to occupy *half* the length of the cell, whereas that of *B. avicularia* extends to very near the bottom. Van Beneden himself points out differences between his species and that of Ellis, though he seems to have been half inclined to identify them.

habit, of an orange-brown colour when recent, but much paler when dried. The cells are somewhat elevated at the upper extremity; and each of them slightly overlaps the one above it. The number of spines is universally, so far as I have seen, three: two are placed on the outer side of the cell—one of them on the upper angle of the aperture, and the second behind it; the third rises from the inner and upper angle. The avicularium is the striking feature of the species. It is of very large size, elongated, with a much produced beak, which is slightly and gradually (not abruptly) curved; the head, as seen from above, has the appearance of being compressed laterally, and altogether wants the full rounded contour which we find in the avicularium of the next species. The ovicells are produced in immense numbers; they are very prominent, owing to the elevation of the cell at the upper extremity, and, as seen in profile, have a very hood-like appearance. The aperture is contracted. The branches are numerous, and set closely together, and wind round the stem in corkscrew fashion. They divide dichotomously a little above the base into two principal segments; and these divide and subdivide, the whole assuming a flabellate character.

BUGULA TURBINATA, Alder.

Plate X. figs. 5-8.

BIRD'S-HEAD CORALLINE, *Ellis*, Corall. pl. xxxviii. figs. G, H.

CELLULARIA AVICULARIA, *Pall.* Elench. 68?: *Gosse*, Devonsh. Coast, 195, pl. x.

BUGULA TURBINATA, *Alder*, Quart. Journ. Micr. Sc. v. 174, pl. xvii. figs. 1-4: *Hincks*, Dev. & Cornw. Cat. 37 (sep.).

Zoarium orange-coloured when living, forming an as-

ending spiral; branches broadly flabellate, dichotomously divided, arching outwards. *Zoæcia* in two to six series, elongated, slightly raised towards the upper end; aperture reaching nearly to the bottom; a single spine at each upper angle. *Avicularia* on the outer cells moderately large, the head much swollen and rounded behind, with a short beak abruptly bent at the point, placed near the top of the cell; *avicularia* on the inner cells small. *Oæcia* subglobose, prominent, the upper part opaque, with a hyaline border round the orifice, which rises into a peak or into a blunt rounded process in front. Height of the shoots from 1 to 2 inches.

Polypide with about 13 tentacles.

HABITAT. On rocks and stones near low-water mark, and in shallow water.

LOCALITIES. Herm, under stones; Guernsey; Menai Straits (Alder): Whitburn (Rev. G. C. Abbes): Seaham Harbour, co. Durham (G. Hodge): Tenby (Dyster): Filey, Yorkshire; Llandudno, dredged off the Ormes Head; Isle of Man; Ilfracombe, very common; South Devon, very fine and abundant, near low-water mark; Swanage Bay, Dorset, on drift wood (T. H.): Falmouth (Cocks); Malahide (Trin. Coll. Collect., Dublin).

This fine species is nearly related to the preceding, with which it had been confounded until detected by the late Mr. Alder's keen and discriminating eye.

It attains a much larger size than *B. avicularia*; the flabellate branches are broader; and the whole habit is stouter. It occasionally reaches a height of two inches, and forms large clustered growths beneath the ledges of rocks, in the clefts and gullies, and on the under surface of stones near low-water mark. As many as a dozen of its lovely spiral shoots will sometimes rise from the mass

of intertwining tubular fibres by which it is attached. When living it is of a rich orange-colour, but fades to a pale straw-colour, or to a pearly white, when dried.

Amongst the other points which distinguish *B. turbinata* from the last species, are the following : the cells are arranged upon the branches in a greater number of longitudinal rows ; in *B. avicularia* there are almost universally two ; in the present form the segments commence with two near the base, but the number rises in the upper portions to three, four, five, and occasionally six. *B. turbinata* has only a single spine on the outer and inner angles of the aperture. Its ovicell is smaller, and is readily distinguished by its hyaline border and the curious process (sometimes slightly pointed, but more usually rounded, at the top) which rises from it and occupies the centre of the front surface.

But the most important distinctive character is supplied by the avicularium, which, with its well rounded head, and short, sharply bent beak, contrasts strongly with the somewhat slender, compressed, long-billed appendage of *B. avicularia*. The avicularium is present on every cell ; but those on the outer edge of the branch, which have more space to work in, are very much larger than the rest. The number on a specimen of average size is very considerable ; and when they are all in active and energetic play, and the polypides are darting in and out, the surface of the zoarium presents a singularly animated scene.

As in the preceding species, the ovicells are developed in amazing numbers, and the branches commonly appear as if studded over with innumerable tiny pearls.

B. turbinata seems to be abundant and widely distributed, but has not yet been noticed in the further north.

BUGULA FLABELLATA, J. V. Thompson.

Plate XI. figs. 1-3.

BIRD'S HEAD CORALLINE, *Ellis*, Corall. pl. xxxviii. fig. 7.CELLULARIA AVICULARIA β , *Pall.* Elench. 68: *Van Ben.* Rech. Bryoz. 48, pl. vi. figs. 1-8.FLUSTRA AVICULARIS, *J. Sowerby*, Brit. Misc. ii. 21, pl. lxxi.: *Flem. B. A.* 506: *Johnston*, B. Z. ed. 2, 346, pl. lxiii. figs. 3, 4.FLUSTRA ANGUSTILOBA, *Lamk.* An. s. Vert. ed. 2, ii. 222.?CRISIA FLUSTROIDES, *Lamx.* Pol. cor. flex. 141.FLUSTRA CAPITATA, *Hogg*, Nat. H. Stockton, 36.ORNITHOPORINA AVICULARIA, *D'Orb.* Pal. Franç. Terr. Crét. v. 322.AVICELLA AVICULARIA, *Van Ben.* Bull. Acad. Roy. Belg. xv. No. 2. 75; 9 (sep.).AVICULARIA FLABELLATA, *J. V. Thompson*, MS. Brit. Mus. 1847: *Gray*, B.M. Radiata, 106.BUGULA FLABELLATA, *Busk*, B.M. Cat. i. 44, pls. li, lii.BUGULA AVICULARIA, forma 2, B. FLABELLATA, *Smitt*, Œfvers. K. Vet. Akad. Förhandl. 1867, 290 & 345; *Flor. Bryoz.* pt. i. 18.

Zoarium composed of a number of flabellate shoots dichotomously divided into numerous truncate segments, somewhat circularly disposed, often slightly convoluted, of an ashy colour when dry. *Zoæcia* multiserial (4-7 rows), oblong, of about equal width throughout, rectangular above, aperture extending to the bottom; two spines at each upper angle, placed one above the other, of which one is usually of considerable length. *Avicularia* placed on the side of the cells, a little below the top, those on the outer edge moderately large, the inner much smaller; head not swollen at the sides, well arched above; beak of moderate length, the point abruptly bent. *Oæcia* rather small, almost semicircular in form, hyaline and smooth, with a wide opening.

Polypide with 14 tentacles.

HABITAT. On stones, shells, crabs, *Flustra foliacea* (very commonly) and other Polyzoa, &c., from moderate depths to deep water; occasionally at extreme low-water mark.

LOCALITIES. A very abundant and widely distributed species. Shetland, 15–50 fms. ; Dourie Voe and haddock-ground, Out-Skerries and Unst (C. W. P.) : St. Andrew's, on *Flustra*, deep water, rather rare (Dr. M'Intosh) : Northumberland, on *Flustra*, &c., from the Coralline zone, not rare ; Bamborough, rocks at extreme low-water mark (Alder) : Peterhead, on *Flustra* (C. W. P.) : Bootle (Tudor) : Filey ; Isle of Man ; Llandudno, N. W. ; South Devon, common (T. H.) : Guernsey (R. S. Cooper) : Cornwall, deep water, common (Couch), &c.

GEOGRAPHICAL DISTRIBUTION. Heligoland (Kirchenpauer) : Ostend (Van Ben.) : Roscoff (Joliet) : Adriatic (Heller and Grube) : Florida, deep water (Pourtales) : Madeira ; Cape of Good Hope (Kirchenpauer).

When dried this species may at once be recognized by its ashy colour. Its habit and mode of growth are also characteristic. When living it is “of a very delicate flesh-colour.”

The rows of cells in the strap-like segments which compose the branch vary in number ; they are never, I believe, fewer than four, and range as high as seven. The cell is oblong and rectangular, and of equal width throughout, while the aperture extends to the very bottom of it. In these respects it differs markedly from the previous species. Of the two spines placed at the top of the cell on each side, the higher are comparatively stout and directed upwards, while the lower pair are slender and bend inwards across the aperture. Two of the spines are generally much more fully developed than the others, sometimes the upper and sometimes the lower pair being the larger. Along the edge of the segments there are usually *three* spines near the outer angle of the cell, but never more than two elsewhere. The avicularium does not ex-

hibit any very marked peculiarity. It is to some extent intermediate between that of *B. avicularia* and *B. turbinata*, not so broad and round at the back as the latter, nor provided with such an elongated beak as the former. The ovicells are extremely delicate in texture, bright and hyaline, and without a trace of sculpture.

B. flabellata attains a height of about one inch.

BUGULA CALATHUS, Norman.

Plate XI. figs. 4-6.

BUGULA CALATHUS, *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 218, pl. vi. figs. 3-8.

Zoarium composed of a number of dichotomously divided branches, springing from a fibrous base, and spreading out regularly on all sides, so as to form a shallow cup; when dried of a yellowish horn-colour. *Zoæcia* multi-serial (3-9 rows), oblong, equally wide throughout, with two spines at each angle above (commonly three at the outer angle on the *edge* of the segments). *Avicularia* on the outer cells very large, on the inner small, placed about a third of the length of the cell from the top, sometimes about halfway down, elongate; the head much produced behind, not much arched above, marked with delicate striæ, which pass off on each side from the median ridge; the beak short in proportion to the head, bent, but not very abruptly, at the point. *Oæcia* subglobular, rather large, with a smooth and polished surface, slightly thickened round the edge in front. Height of a large specimen $\frac{3}{5}$ inch, diameter $1\frac{1}{4}$ inch.

HABITAT. Under stones between tide-marks and in shallow water.

LOCALITIES. Herm, between tide-marks (A. M. N.): off

the South-Devon coast, on *Eschara foliacea*; off the Thatcher rock, Torbay, in about 9 fms. (T. H.).

The differences between the present species and *B. flabellata* are almost entirely confined to habit and mode of growth. The zoarium of the former is shaped like a shallow cup, perfectly simple and without any trace of convolution; the shoots or branches which compose it are shorter, and divided into a much smaller number of segments, than those of the latter; the growth is more spreading than that of *B. flabellata*, the shoots of which are stout, erect, and much divided. The colour of the two, when dried, presents a striking contrast. When living, *B. calathus* is of a light straw-colour. If we examine the minute structure, we find a close agreement in all essential points. The cells, ovicells, and avicularia are all on a larger scale than in the other species; and the latter seem to exhibit some slight differences in form and proportion of parts. They are more elongate; the head is more produced behind, and not so much arched; and the beak is perhaps proportionally shorter, though there is a good deal of variation in this respect. The striæ are more clearly defined; but they are present also on the avicularia of *B. flabellata*. On the other hand, the shape of the cells and ovicells, the number of the spines, the position and general character of the avicularium are the same in both. Both are multiserial; and in both the number of rows ranges very much within the same limits.

Mr. Norman describes the spines of the present species as "stout and blunt;" but when fully developed they closely resemble those of *B. flabellata*. The upper are stouter than the lower, but the latter usually (not universally) taller than the former. They occupy the same relative positions as in the other form, and exhibit the same differ-

ences of character. As in *B. flabellata*, there are almost always *three* spines at the outer angle of the aperture, along the edge of the segments.

I confess that I rank this beautiful form as a distinct species with some hesitation. It may be a question whether, in the face of its essential agreement with *B. flabellata* in all the leading structural points, the differences which it undoubtedly exhibits should be regarded as more than varietal. In the absence, however, of intermediate forms it seems right to give it a separate name.

Viewed with reference to *B. flabellata*, *B. calathus* is a dwarf form of simple habit, in which the less luxuriant development of the zoarium is accompanied by an increase in the size of the individual elements of the structure (cell, avicularium, &c.).

In the dried state the two are at once distinguishable by the difference in colour.

BUGULA PLUMOSA, Pallas.

Plate XII. figs. 1-5.

SOFT-FEATHERED CORALLINE, *Ellis*, Corall. 33, no. 1, pl. xviii. fig. a, A.

? SERTULARIA FASTIGIATA, *Linn.* Syst. ed. 12, 1314.

CELLULARIA PLUMOSA, *Pallas*, Elench. 66: *Couch*, Corn. Faun. iii. 128, pl. xxiii. fig. 4.

CELLARIA PLUMOSA, *Ellis & Sol.* Zooph. 21.

CRISIA PLUMOSA, *Lamx.* Bull. Soc. Phil. 1812, iii. 185; Pol. coral. flex. 62.

CRISIA FASTIGIATA, *Templeton*, Ann. N. H. ser. 1, ix. 468.

BICELLARIA PLUMOSA, *Blainv.* Actinol. 459.

CRISULARIA PLUMOSA, *Gray*, B.M. Cat. Rad. 111.

BUGULA PLUMOSA, *Busk*, B.M. Cat. i. 45, pl. liv. figs. 1-5: *Alder*, Supp. North. Cat., Trans. Tynes. Nat. F. C. v. (20 sep.): *Heller*, Bryoz. d. Adriat. Meeres, 15.

Zoarium consisting of slender, feathery, confervoid tufts; branches flabellate, dichotomously divided into narrow linear segments, disposed spirally round the central

stem; when living, of a bright buff colour. *Zoæcia* biserial, alternate, elongated, much attenuated below; aperture occupying three quarters of the front, as wide as the cell above, below narrowed almost to a point, the outer margin raised towards the top and somewhat bent inwards, running out above into a spine. *Avicularia* very small, placed at a short distance below the top of the cell. *Oæcia* globular.

HABITAT. On shells, &c., from between tide-marks to deep water.

LOCALITIES. On scallop and other shells, Salcombe Bay, not uncommon; Fleetwood, on a buoy (T. H.): Polperro, rare, on rocky ground, not far from shore (Couch): Falmouth (Miss Warren): Northumberland, from the deep-water boats (Alder): Seaham Harbour, co. Durham, between tide-marks (G. Hodge).

GEOGRAPHICAL DISTRIBUTION. Adriatic (Grube): Roscoff, pretty common (Joliet).

Ellis's name for this species, "the soft-feathered Coral-line," is very appropriate. It grows in tall slender tufts, tapering above into a fine spire-like point, and is of very delicate and graceful habit. Mr. Couch gives the height at four inches, or more commonly two and a half or three. In Salcombe Bay it is found growing over the outer surface of old scallop shells, but of much humbler size, not exceeding an inch and a quarter.

The avicularium is remarkably small; and this is its chief peculiarity. The head is very much arched, the surface smooth; the beak continues straight almost to the extreme point, where it is very slightly bent or hooked. The single spine on the outer angle of the cell is sometimes short and conical, but is very commonly produced into a sharp spike-like process of considerable length.

The radical fibres are thin and membranaceous, and form a dense and tangled mass at the base of the shoots.

I have not been able to give many localities for *B. plumosa*; for the species was commonly confounded with *B. purpurotincta* until Mr. Alder pointed out and defined the differences between them, and it is difficult to decide in many cases which of the two is intended. I have recorded none about which there could be any doubt.

BUGULA GRACILIS, Busk, var. UNCINATA, Hincks.

Plate XV. figs. 1-4; Plate XII. figs. 6, 7.

BUGULA GRACILIS, *Busk*, Quart. Journ. Micr. Sc. vi. 125, pl. xix. fig. 1.

Zoarium composed of many slender shoots, about one inch in height, united so as to form bushy tufts, of a pale horn-colour when dry; branches flabellate, somewhat spirally disposed, crowded, dichotomously divided into narrow segments, longest in the middle of the shoot and diminishing above and below. *Zoæcia* biserial and alternate, elongate, narrowing slightly downwards, with two spines on the outer side above, one of them on the free angular extremity of the aperture, and one (the longer) behind it, and one on the inner and upper angle; aperture rather narrow, occupying two thirds of the length of the cell or more, somewhat contracted below, turned inwards towards the median line. *Avicularia* small, placed on the outer margin, a little below the top of the aperture. *Uncinate prehensile appendages* distributed in considerable numbers over the dorsal surface, and replacing the ordinary radical tubes. *Oæcia* (?).

HABITAT. Unknown.

LOCALITIES. I am unable to give any British locality

for this species ; but I have a specimen in my collection which was obtained on our coasts, and which I had wrongly referred to *B. plumosa*, until the examination of fine examples of the same form from the United States directed my special attention to it.

GEOGRAPHICAL DISTRIBUTION. Madeira (J. Y. J.) : Lynn, Massachusetts (Rev. W. Hincks).

A reference to Mr. Busk's description of this species in the 'Microscopical Journal' will show that it differs in several important points from the one given above. I should hardly have felt justified in assuming the identity of *B. gracilis* and the present form (which I shall distinguish as *B. gracilis*, var. *uncinata*), had not Mr. Busk stated that his specimen of the former was a small one, so small indeed (it is implied) as to render it difficult to determine the habit satisfactorily.

The general character of the zoëcium is undoubtedly the same in both ; but *B. gracilis*, Busk, is represented as having only two spines, whilst its aperture is described as not extending below the middle of the cell. At the same time there is no mention in Busk's diagnosis of the remarkable appendages which are present on every shoot of the var. *uncinata*, in both the British and North-American examples.

As to these differences, it may be remarked that the spine or denticle on the outer angular extremity of the aperture is rather inconspicuous, and might easily be overlooked, especially in dried specimens, and that the aperture may not improbably vary in length. With respect to the appendages, on a fragmentary specimen they might not be present ; or it is possible that they may only be developed under certain local conditions. Looking to the great *general* similarity of the two forms,

it seems better to regard them as essentially identical (at least provisionally) than to run the risk of introducing a false species. Should further acquaintance with them show them to be specifically distinct, the present form would rank as *B. uncinata*.

In some respects *B. gracilis* bears a considerable resemblance to *B. plumosa*, but is of smaller size and of dissimilar habit. It differs from it, too, in possessing three spines instead of one, and in the character of the aperture. The two free extremities of the margin above are more prominent than in *B. plumosa*, the inner one especially being carried forwards so as to be on a level with the outer, and each of them being crowned with a spine. The aperture is also much more decidedly turned inwards towards the middle of the branch than in the latter species. I have never met with the hooked appendage on *B. plumosa*.

In the number of the marginal spines *B. gracilis* agrees with *B. avicularia*; but they are very different in the two species. In the former the uppermost of the two on the outer side resembles the single spine of *B. plumosa*; that on the angular extremity of the aperture in front of it is a strong denticle. The inner spine is not directed upwards like that of *B. avicularia*, but projects at right angles to the surface of the zoarium, and is placed exactly opposite to the denticle; the cells and avicularia of the two species are also dissimilar.

As I have mentioned, this form is furnished with a very curious appendage, which must be regarded as a modification of the radical tube. It originates on the dorsal surface of the cell near its base, and stands out from it at right angles. It consists of a rather stout tubular process, which widens upwards from its point of origin, and at its free extremity bifurcates, each

arm again dividing and subdividing, and the ultimate ramules forming a number of curled, tendril-like claspers (Plate XII. figs. 6, 7), by means of which we may suppose the slender tufts fix themselves or cling to some neighbouring support. These prehensile appendages are distributed in great numbers over the zoarium, ranging from its upper portions to its very base. The tuft commences with one or two cells, disposed in single series; and two of the appendages spring one on each side from the primary cell, close to its lower extremity.

We have in this case another adaptive modification of the simpler structure, correlated, in all probability, with some peculiarity of habitat. I have never met with any trace of the ordinary radical tubes on *B. uncinata*; the appendages abound on the lowermost portion of the shoots; and in all cases it is more or less invested by some fibrous material, in which the base of the zoarium was probably plunged, and to which it was fast bound by its apparatus of hooks*.

BUGULA PURPUROTINCTA, Norman.

Plate XII. figs. 8-12.

CELLULARIA FASTIGIATA, *Dalyell*, Rare and Rem. An. Scotl. i. 236, pl. xlv. (not the *Sertularia fastigiata* of Fabricius).

CELLULARIA PLUMOSA, *Johnst.* B. Z. ed. 2, 341, pl. lxi.: *Sars*, Reise i Lofoten og Finn. 29.

BUGULA FASTIGIATA, *Alder*, Cat. Zooph. North. and Durh. 59: *Sars*, Geol. og Zoolog. Reise i sommeren 1862, 37.

BUGULA AVICULARIA, forma FASTIGIATA (part.), *Smitt*, Krit. Fört., Öfv. Vetensk.-Akad. Förhandl. 1867, 291 and 346, pl. xviii. figs. 16-18.

BUGULA PURPUROTINCTA, *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 219.

Zoarium stout, bushy, irregularly branched, of a purplish-

* In the footnote on page 30, the name of the present species should be substituted for *B. plumosa*.

red colour when dry. *Zoæcia* biserial, much elongated, attenuated below; aperture extending almost to the bottom of the cell, wide above, almost pointed below, with a stout cylindrical spine, jointed at the base, on the upper and outer angle, and a denticle in front of it. *Avicularia* placed about halfway down the cell, large, elongate, the head not much arched, the beak curved for about a third of the length, with a very short hook at the extremity. *Oæcia* extremely shallow, hemispherical, as viewed sideways, the aperture occupying almost the whole of the front.

HABITAT. In the Laminarian region, and on shells, &c., from deep water.

LOCALITIES. Cullercoats, common (Coppin): south coast of Durham, extremely abundant (J. Hogg): Scotland (Dalyell): Shetland, 5–7 miles east of Balta, 40–50 fms., scarce (A. M. N.): Seaham Harbour (G. Hodge): Scarborough (Bean): St. Andrews, Coralline ground, attached to shells, abundant (Dr. M'Intosh): Loch Ryan, oyster-shells (Landsb.): Filey, Yorkshire; Menai Straits (T. H.): Wick, abundant; Peterhead, rare (C. W. P.): Clontarf (Trin. Coll. collect.).

GEOGRAPHICAL DISTRIBUTION. Christiansund and Bejan, 40–60 fms.; Lofoten (M. Sars): Bahusia and Norway, common, 30–130 fms. (Smitt): St. George's Banks, 110 and 150 fms. (Smith and Harger).

This species had been confounded with *B. plumosa* until Mr. Alder pointed out, with his accustomed accuracy and clearness, the characters which separate them.

B. fastigiata is of stouter and stiffer habit, and much more bushy and irregular in its mode of growth than the "soft-feathered Coralline." The branches are large and spreading, and divided into a multitude of narrow seg-

ments. The older portions of the zoarium are brown, and coarse in appearance ; but the newer terminal portions of the shoots are of the most delicate whiteness and perfectly transparent. This in itself gives a very peculiar and distinctive appearance to the species. The material of which the cells and ovicells are composed is very thin and papyraceous. The cells are much longer than those of *B. plumosa*, and with something of a cylindrical character ; and the aperture occupies a larger proportion of the front. The stout, cylindrical, and jointed spine at the top of the cell differs widely from the sharp and rather slender spike of the other species, with which indeed, as Alder has remarked, it hardly corresponds. The true equivalent of the latter is clearly the small denticle, which usually rises in front of the larger spine from the free angular extremity of the margin. The avicularium of the present species is very large, as long as the breadth of the cell, and differs in shape from that of *B. plumosa*. Perhaps the most striking difference is found in the shape of the ovicell, which in the latter is globular and of the usual type, while that of *B. fastigiata* is extremely shallow ; as seen in profile (Pl. XII. fig. 12) it is hemispherical, the aperture occupying nearly the whole of the front and looking straight outwards. So shallow is it that it only partially covers the embryo in its later stages.

When dry *B. fastigiata* takes on a rich purplish-red colour, a peculiarity which has suggested the specific name, and by which it may be at once recognized.

The polypide has, according to Sars, 14 tentacles, while Dalyell gives the number at 16-18.

The present species rises from a dense mass of intertwining fibres to a height of about 3 inches. It is a northern form, not occurring on our southern and western coasts.

BUGULA MURRAYANA, Johnston*.

Plate XIV. figs. 2-9.

FLUSTRA MURRAYANA, *Johnst.* Br. Z. ed. 2, 347, pl. lxiii. figs. 5, 6.?? SERTULARIA SPIRALIS, *Olivi*, Zool. Adriat. 291 & 313, pl. vi. fig. 2 a, A.FLABELLARIA SPIRALIS, *Gray*, Cat. Brit. Rad. 106.AVICELLA MULTISPINA, *Van Ben.* Bull. Acad. Roy. Belg. xv. no. 2 des Bulletins (1849), 76, pl. x. figs. 7, 8 (p. 10, sep.).BUGULA MURRAYANA, *Busk*, B.M. Cat. i. 46, pl. lix.: *Smitt*, forma 1 and forma 2, B. QUADRIDENTATA, *l.c.* 291 and 349, pl. xviii. figs. 19-26 (?27).MENIPEA FRUTICOSA, *Packard*, List Labrador Mar. An. 9, pl. i. fig. 3.

Zoarium consisting of a number of shoots, much divided dichotomously into broad ribbon-like segments, truncate at the top, and forming entangled, spreading, bushy tufts. *Zoæcia* multiserial (4-12 rows), alternate, oblong, truncate above, and slightly narrowed below (boat-shaped); aperture reaching nearly to the bottom; an erect spinous process at each angle above, and a variable number of marginal spines (2-5 on the outer edge and 1-3 on the inner) curving inwards †. *Avicularia* on the front of the cells below the aperture, (those on the marginal cells about three times as large as the rest,) elongated, the head moderately arched, well rounded behind, surface smooth and polished; beak very short in proportion, with a much bent extremity; mandible long, sharply pointed. *Oæcia* large, subglobose, glistening, almost membranous, with radiating striæ. *Radical fibres* very long and stout, and wrinkled transversely, given off from the side of the marginal cells towards the lower part of the shoots.

Height about $1\frac{1}{4}$ inch. Of a light straw-colour when dry.

* The specific name originated with Mr. Bean, and was communicated by him in MS. to Dr. Johnston, by whom it was first published.

† There is occasionally a spine at the bottom of the cell near the place usually occupied by the avicularium.

VAR. α (*fruticosa*, Packard). *Zoarium* consisting of many shoots, divided dichotomously into very narrow linear segments, forming tufts of very delicate habit. *Zoæcia* 2-4 in a row, alternate, an erect spine at the two upper angles, and a single marginal spine on each side a little below the top. Large marginal avicularia wanting (?).

HABITAT. On zoophytes, *Flustra foliacea*, shells, stones, &c., chiefly from the Coralline ground.

LOCALITIES. Scarborough, deep water, very rare (Bean) : Northumberland (Miss Dale) : ditto, from the fishing-boats, Cullercoats, rather rare, more common from the deep-water (five-men) boats (Alder) : coast of Yorkshire ; Orkney, common in deep water (Lieut. Thomas) : Shetland (E. Forbes) : The Minch (A. M. N.) : Lamlash Bay (T. H.) : Stonehaven (Lady Keith Murray) : Peterhead and Wick, plentiful (C. W. P.) : Leith and Newhaven, on the fishermen's nets (D. Landsb. Jun.) : St. Andrews, plentiful from the Coralline ground (Dr. M'Intosh) : Dublin Bay, on *Hydrallmania falcata*, *Flustra foliacea*, and in bivalve shells (M'Calla).

GEOGRAPHICAL DISTRIBUTION. Skandinavian coasts ; Grötsund, Finmark, 100 fathoms ; Spitzbergen (Smitt) : Greenland, Holsteinborg Harbour, 7-35 fathoms, both normal and var. α ; Godhavn Harbour, Disco, 5-20 fathoms, var. α ('Valorous' Exped.) : South Labrador, var. α , common (Packard) : off Frederickshaab, Davis Straits, 100 fathoms, var. α (Wallich) : North Sea (Van Ben.) : Gulf of St. Lawrence (Dawson) : New England (Kirchenpauer) : St. George's Banks, 28-150 fathoms (Smith and Harger).

The remarkable variety, which was first described by Packard as a species under the name of *Menipea fruti-*

cosa, and which Lovén subsequently distinguished as *B. quadridentata*, presents a striking contrast in general aspect to the normal *B. Murrayana*. Its slender habit and mode of growth are very much those of a *Scrupocellaria*; while the typical form, with its broad truncate segments, reminds us of a *Flustra*.

After an examination of the minute characters, however, there can be no doubt that the two are referable to one and the same species. The variety owes its very marked facies simply to a reduction in the number of the rows in which the cells are disposed. The other structural characters are the same in both, with the single insignificant exception that the marginal spines are less numerous in the form *fruticosa*. The case is an interesting one as showing how completely the external appearance of a species may be changed without the modification of a single essential character.

The shoots at their origin are uniserial, three or four cells being linked together, as in *Eucratea*.

On the dorsal surface the cells appear of a somewhat fusiform shape ("en forme de barillet," Van Beneden), separated by deep furrows, and marked here and there by transverse black and white bands. The surface is smooth and shining. On each of the marginal cells there is a *pore* placed on the back a little below the spinous process on the outer angle, which marks the point from which, in the lower part of the shoot chiefly, the radical fibres originate. Above they are but rarely developed.

The long and remarkably stout radical fibres are developed in great profusion; they attach themselves by means of a number of fibrils given off from the free extremity, which adhere firmly to any neighbouring support.

B. Murrayana seems to be in great measure a northern form, and to be especially at home in the extreme north. The var. *fruticosa* prevails in the Arctic seas. The identification of this species with the *Sertularia spiralis* of Olivi is more than doubtful, and is so regarded by Heller, who has not himself obtained it in the Adriatic.

Genus BEANIA, *Johnston*.

Der. Named after William Bean, the well-known Scarborough naturalist.

GENERIC CHARACTER.—ZOARIUM *subcorneous or calcareous, erect or decumbent*. ZOÆCIA *sessile, erect, scattered, united one to the other by a slender tube, originating from the dorsal surface or from the side near the base; aperture occupying the entire front, the margin furnished with hollow spinous processes arching over the opening; mouth terminal*. OÆCIA and AVICULARIA *wanting*.

THE links which bind the present genus to the Bicellarian group have already been referred to. It has also affinities, though probably more remote, with *Aetea*. The tubular connexions between the cells may be regarded as of the nature of pedicels; and we may therefore compare such a form as *B. mirabilis* with *A. truncata* (see Plate II. fig. 3), to which in several points it bears a curious resemblance.

The intercellular tubes are in no sense the equivalent of a creeping fibre; nor are they in any way concerned in attaching the zoarium to its place. This is effected by a special arrangement. From each cell (in *B. mirabilis*) a membranaceous tubular process is given off from a definite point on the dorsal surface near the base (woodcut, fig. 4 *a*), varying in length according to circumstances, and terminating in a small disk, furnished with a number

of fibrils or rootlets, by means of which it adheres firmly to the shell or weed over which the polyzoon creeps. After the disappearance of the radical fibre itself, its point of origin is marked by a small tubular projection on the surface of the cell. In *Diachoris*, I find, attachment is effected in precisely the same way.

The zoarium, then, in the genus *Beania*, is composed of a number of pedicellate cells, which spring one from the other in linear series, from which other lines are given off at right angles. The secondary series originate at opposite points on the sides of the cell, near its base. The whole structure is generally decumbent, and in this condition is attached by radical fibres emitted from the individual cells.

A Patagonian species, *Beania australis*, Busk, is said to form a connected frond at times, and in this state must approach very closely to *Diachoris*.

Three species have been described besides our own *B. mirabilis*:—*B. Swainsoni*, Hutton, an erect phytoid form from New Zealand (apparently taking on to some extent the habit of *Bugula*); *B. admiranda*, Packard, from Labrador; and the Patagonian form just referred to.

BEANIA MIRABILIS, Johnston.

Plate IV. figs. 8–10.

BEANIA MIRABILIS, *Johnst.* Ann. N. H. ser. 1, v. 272; *B. Z.* ed. 2, 372, woodc. figs. 69, 70: *Busk*, B.M. Cat. i. 32, pl. xxiv. figs. 4, 5: *Hincks*, Ann. N. H. ser. 2, xv. 129: *Landsb.* Pop. Hist. *B. Z.* 369, pl. xix. fig. 25: *Smitt*, Cefv. 1867, no. 5, 292 & 357: *Heller*, Bryoz. Ad. M. 13.

Zoarium adherent by means of radical fibres given off from each cell. *Zoæcia* subcalcareous, boat-shaped, contracted above and bulging below; two denticles above

the mouth; spines 7-10, on each side of the aperture; the connecting tube slender and smooth; opposite branches given off from the base of the cells.

Polypide with 20 tentacles.

RANGE OF VARIATION. This seems to be very narrow. The only difference I have observed which is worth noting is in the number of the spinous processes on the margin of the aperture. Johnston gives it at 5-7, but it often reaches 10 or even more; 8 or 9 seem to be the usual quota in well-developed specimens. The uppermost pair are stouter than the rest and suberect.

HABITAT. On weed (especially *Laminaria*), zoophytes, shells, stones, &c., between tide-marks; more rarely on shells from deep water.

LOCALITIES. Scarborough, on shells and rock, and on *Cellularia* (*Bugula*) *avicularia* at or within low-water mark (Bean): dredged off Scilly, on *Pecten maximus* (M'Andrew): Peterhead and Wick, very rare (C. W. P.): off the coast of Antrim, on *Pectunculus* (Hyndman): Filey, on shell brought in by fishermen; Lamlash, Arran; Isle of Man, on weed; Swanage, on *Laminaria*; off Lulworth Cove, in shallow water; Ilfracombe, common, on stones in rock-pools; Exmouth, on *Bugula turbinata*, *Laminaria*, &c.; Torbay, stones between tide-marks; Herm, plentiful; Guernsey; Plemont, Jersey (T. H.): Sidmouth (Mrs. Gatty): Eastbourne (Roper): Hastings, rare (Miss Jelly): Shanklin, Isle of Wight (H. Lee): off Falmouth, on a crab-float (Cocks). Not recorded from Shetland.

GEOGRAPHICAL DISTRIBUTION. Scandinavia (Lovén and Smitt): Adriatic, at Lesina, on an Alga, one specimen (Heller): Roscoff, dredged, and at low-water mark (Joliet).

This is a charming species, and one of the collector's treasures. Not that it is really rare, though from its minuteness it readily escapes detection; but the beauty of its spinous cells and the singularity of their form make it a general favourite. It is perhaps most easily obtained by a careful search amongst the *Laminaria*-roots, at extreme low-water mark. Over these it often creeps in great luxuriance, in company with *Aetea anguina* and other pygmy forms.

The polypide has about 20 tall and delicate tentacles, forming a singularly graceful bell. It is of large size, and, when fully expanded, projects very far beyond the orifice, the body at such times only occupying about the upper third of the cell. A long, straight œsophagus leads from the pharynx to the stomach. The flexible portion of the cell, which unrolls as the animal issues, is of unusual length. Amongst the marine Polyzoa, I know of no polypide which excels it in beauty, unless it be that of *Flustrella hispida*.

Family V.—Notamiidæ.

GEMELLARIADÆ (part.), Busk.

ZOÆCIA in pairs, each pair arising by tubular prolongations from the pair next but one below it; at each bifurcation a new series of cells intercalated into the branches.

THE remarkable structure of the zoarium which distinguishes *Notamia bursaria*, entitles it to stand as the type of a separate family. It has certainly no close affinity with *Gemellaria*. Apart from other differences, the

character of the zoæcium is totally distinct in the two ; while the point in which they agree—the disposition of the cells, opposite to one another in pairs, is of very secondary importance.

The Australian genus *Calwellia*, Wyville Thomson, resembles *Notamia* to some extent in the structure of the zoarium, and should perhaps be included in the present family.

Genus NOTAMIA, *Fleming*.

NOTAMIA (sp.), Flem. Br. An. 1828 : Busk.

EPISTOMIA, Flem. Br. An.

SERTULARIA (sp.), Linnæus.

CELLULARIA (sp.), Pallas.

CELLARIA (sp.), Ellis & Solander : Lamk.

DYNAMENA (sp.), Lamouroux.

GEMICELLARIA, Blainville, 1830.

GENERIC CHARACTER.—ZOARIUM *consisting of a creeping tubular stem and erect shoots. ZOÆCIA united laterally in pairs ; above each pair two stemmed avicularia, originating, one on each side, from the inferior tubular prolongation of one of the cells immediately above. OÆCIA none.*

It is no easy matter either to determine or to explain the complex structure of the zoarium in this genus. Without entering into details, it may be sufficient to state that the pairs of cells do not arise immediately one from the other, but that each pair is connected with the next pair *but one* above it by tubular prolongations, which are given off from the upper and inner angles of the cells composing it. At each bifurcation of the shoot, the two series of cells composing the internode immediately below it separate, and each of them forms half of one of the branches resulting from the division ; and at this point two new series are introduced to make each branch complete. The several

series of cells which compose the shoot are continuous from their point of origin to the termination of the branch to which they belong; *e.g.* the series which originate from the two primary cells pass uninterruptedly to the extremities of the branches of which they constitute the halves. And the same holds good of all the new series intercalated at the bifurcations. It will be noted that above each bifurcation there is only a single cell instead of the usual pair. There are some irregularities in the composition of the first internode; but the above is the general plan of the structure.

Those who desire to master all its minutiae may refer to Mr. Busk's paper in the 'Transactions of the Microscopical Society,' in which he has given an exhaustive account of the structural details*.

The zoecium of *Notamia* bears a general resemblance to that of *Bicellaria*.

NOTAMIA BURSARIA, Linnæus.

Plate IV. figs. 1-5.

SHEPHERD'S-PURSE CORALLINE, *Ellis*, Corall. 41, pl. xxii. figs. *a*, *A*: *Johnst.* B. Z. ed. 2, i. 294, pl. li. figs. 1, 2.

SERTULARIA BURSARIA, *Linn.* Syst. 1314.

CELLULARIA BURSARIA, *Pall.* Elench. 65.

CELLARIA BURSARIA, *Ell. & Sol.* Zooph. 25: *Lamk.* An. s. V. ed. 2, ii. 189.

DYNAMENA BURSARIA, *Lamx.* Pol. cor. flex. 179.

NOTAMIA BURSARIA, *Flem.* B. A. 541: *Busk*, Trans. Micr. Soc. ii. (1849), 110, pl. xxv.; B.M. Cat. i. 36, pl. xlv. figs. 1-4.

GEMICELLARIA BURSARIA, *Blainv.* Dict. Sc. N. lx. 445: *Landsb.* Pop. Hist. 297, pl. xvi. fig. 59.

SERTULARIA BURSA, *Turt.* Brit. Faun. 216.

EPISTOMIA BURSARIA, *Gray*, B.M. Rad. 82.

* 'Transactions of the Microscopical Society of London,' vol. ii. (1849), pp. 110-121, pl. xxv.

Zoarium pearly, much branched dichotomously, the branches curled at the extremities. *Zoæcia* bracket-like, broad above, and produced at the outer angle into a sharp point, narrowed below; the aperture occupying almost the whole of the front; the oral valve semicircular, set somewhat obliquely near the inner angle above. *Avicularia* borne on short tubular stems and shaped like a tobacco-pipe, the head tumid, widening from the base upwards, with a pointed mandible and a minute beak. *Oæcia* none.

Polypide with 10 tentacles.

HABITAT. On *Fuci*, stones, shells, Crustacea, &c., in shallow water.

LOCALITIES. Devon, on *Hydrallmania falcata* (Mrs. Griffiths) : Isle of Wight, abundant (C. W. P. and Busk) : Swanage Bay, Isle of Purbeck, extremely fine and plentiful, 3-10 fathoms (Busk and T. H.) : Cromer (Mr. Wigham) : Hastings, on *Rytiphlea pinastroides* (M. Tumanowicz) : Brighton (Mr. Pike) : Weymouth (Bowerbank) : off Essex; Southend and Ramsgate (*teste* Busk).

Notamia bursaria is no less remarkable for its beauty than for the singularity of its structure. It grows in exquisitely soft and feathery tufts, of a pearly whiteness, formed of most delicate material, and gracefully curled at the extremities. The erect shoots rise at intervals from a rather stout creeping tube, which is filled with a yellowish granular substance. The stem is slightly attenuated towards the point of origin, and for some distance above it is destitute of cells. The two primary zoæcia are quite rudimentary, and originate in a slight dilatation of the stem, which is divided by a central wall or partition into two chambers. From these a second pair proceed, which approach more nearly to the normal condition; they

differ from it, however, in size, and to some extent in shape; and one of them bears on its outer side a small and peculiarly formed avicularium. From this second pair two series of zoœcia are developed according to the plan which has been already described.

Scattered here and there over the zoarium gigantic cells frequently occur, resembling in form the ordinary zoœcium, but twice as large. They are rendered opaque by their contents, and are very conspicuous objects. I have not been able to make a minute examination of their internal structure; but it is not improbable that they may have a reproductive function.

Two avicularia are interposed above each pair of cells, except immediately below a bifurcation, where one of them is suppressed. These appendages are given off laterally from a central tube which traverses the posterior surface of the zoarium, and bear a very close resemblance in form to a tobacco-pipe. Some of them are very much larger than the rest, more than double the size, very tumid, and almost of equal width throughout (Plate IV. fig. 5).

“This most beautiful pearl-coloured Coralline,” as Ellis calls it, has generally been accounted extremely rare. It is certainly local; but in the south it is not at all uncommon*, and at certain points it occurs in extraordinary profusion. Mr. Busk has told us how common he found it to be in Swanage Bay. In the same locality I have dredged it in large quantities, almost every haul bringing it up (generally in company with the extraordinary Hydroid

* Dr. Landsborough remarks that “*Rytiphlea pinastroides* seems its favourite weed;” and he adds, “from the number of little *bittocks* which I have detected on various weeds from the South of England, it is evident that it is not rare.”—*Pop. Hist. Brit. Zooph.* p. 298.

Ophiodes mirabilis, mihi). Wonderful specimens were obtained, consisting of multitudes of the feathery tufts clustering thickly about the bunches of weed. It is also common off the neighbouring coasts of the Isle of Wight. On the Devon coast it must, I should think, be extremely rare, as after a prolonged and careful examination of this region, extending over many years, I have never met with a specimen.

Family VI.—Cellariidæ.

ESCHARIDÆ (part.), Johnston.

SALICORNARIADÆ, Busk.

? VINCULARIADÆ, id.

CELLARIÆ, Smitt.

SALICORNARIDEA (part.), Reuss.

ZOÆCIA usually rhomboidal or hexangular, disposed in series round an imaginary axis, so as to form cylindrical shoots. ZOARIUM erect, calcareous, dichotomously branched.

I HAVE not included the jointed condition of the zoarium in the above diagnosis, as it must be accounted more than doubtful whether this character is of sufficient importance to warrant the relegation of such closely allied forms as *Cellaria* and *Vincularia*, Defrance, to different family groups. All the British members of the family, however, possess an articulated zoarium.

The *Cellariidæ* are connected through the genus *Nellia*, Busk, with the *Cellulariidæ*, whilst in the character of their avicularia and the immersed condition of the ovicells they agree with the *Flustridæ*.

Genus CELLARIA, *Lamouroux* (part.).Der. from *cella*, a cell.

CELLARIA (part.), Solander : Lamouroux, Bull. Soc. Philom. 1812 :

D'Orbigny : Smitt.

SALICORNARIA, Cuvier, Règne An. 1817 : Johnst. : Busk, &c.

FARCIMIA, Fleming, Brit. An. 1828.

SALICORNIA, Schweigger, 1819.

GENERIC CHARACTER.—ZOARIUM *jointed at intervals, the internodes connected by flexible horny tubes. ZOÆCIA depressed in front, and surrounded by a raised border, disposed in quincunx. AVICULARIA immersed, irregularly distributed, situated above a cell or occupying the place of one. OÆCIA immersed.*

I WILL give as briefly as I can my reasons for reverting to Solander's name *Cellaria*, as applied by Lamouroux, and displacing Cuvier's *Salicornaria*, which has obtained so much currency through the classical works of Johnston and Busk. A glance at the synonymy of *Cellaria fistulosa* must convince any one of the importance of maintaining with rigor the law of priority in scientific nomenclature. The earliest name, *accompanied by a sufficient diagnosis*, has an indefeasible claim to adoption; and to set it aside for any secondary reasons seems to me to be a serious offence against scientific order.

The facts in the present case are as follows:—*Cellaria* was introduced by Solander, in his edition of Ellis's posthumous work (1786), as the designation of a miscellaneous assemblage of forms, a purely artificial group, which only existed to be dismembered.

In 1812, Lamouroux adopted it as the name of a genus, of which he expressly constituted *Cellaria salicornia* (= *C. fistulosa*) the type. He says, "J'ai conservé le nom de *Cellaire* au groupe dont les polypiers avaient

pour type le *Cellaria salicornia*, un des plus remarquables et des plus anciennement connus”*. It is true that he has included in the genus one or two forms which are not referable to this type; but he has himself supplied us with the test by which we at once recognize and reject them as aliens. His genus *Cellaria*, according to his own showing, embraces those species only which exhibit the same structural features as *Cellaria fistulosa*.

Instead of rejecting Lamouroux's genus altogether because he has wrongly referred species to it which do not belong to it, the proper course surely is to retain it for the type which he has himself selected for it, and to allow the foreign elements to find their place elsewhere. I cannot share Mr. Busk's apprehension that it may be “confounded with the more extensive *Cellaria* of Dr. Solander” and others, as the latter has long since been resolved into its elements, and ceased to exist but as a name. Were there, however, any ground for such apprehension, I should hesitate on this account to set aside a genus which has such undoubted priority†. Cuvier's *Salicornaria* was published in 1817.

Lamouroux's name has been adopted by Smitt in his ‘Critical Catalogue’ of the Skandinavian Polyzoa; and he has stated very clearly the grounds on which he bases his decision‡.

In this well-marked form the surface of the cylindrical internodes which compose the zoarium is divided into regular, (usually) rhomboidal, or hexagonal, or oval areas by the walls which close in the front of the cells. The

* Hist. d. Pol. cor. flex. p. 125.

† Mr. Busk afterwards adopted the name *Cellaria* (Quart. Journ. Micr. Sci. (n. s.) vii. p. 65), and promised his reasons for doing so; but he has since reverted, probably through mere inadvertence, to *Salicornaria* (ibid. viii. p. 280).

‡ ‘(Efversigt af Kongl. Vetenskaps-Akademiens Förhandlingar,’ 1867, pp. 383, 384.

latter is always much depressed, and consists of a calcareous lamina, pierced by a more or less semicircular orifice. The avicularia are of a very simple type, and exhibit a comparatively slight modification of the ordinary zoecium. The ovicells are completely concealed, as in *Flustra*; and the opening is placed at the upper extremity of the area, a little above the oral aperture.

The *Cellariæ* are widely distributed, members of the group occurring in New Zealand, Tasmania and the Australian continent, and Cumberland Island (on its east coast), the Falkland Islands, South America, South Africa, Madeira, the Mediterranean, Great Britain, North Sea, Greenland, and Spitzbergen, south coast of North America, Indian Ocean. The genus possesses a very cosmopolitan representative in our own *C. fistulosa*.

The *Cellariæ* reach back as far as the Cretaceous epoch at least, during which they formed a very small group, while at the same period a large number of the allied *Vinculariæ* flourished.

The present genus ranges from shallow to very deep water. We learn from Sir Wyville Thomson that forms referable to the family were obtained during the 'Challenger' voyage, at depths between 2000 and 3000 fathoms, a sterile region, where other animal life was scarce*.

CELLARIA FISTULOSA, Linnæus.

Plate XIII. figs. 1-4.

BUGLE CORALLINE. *Ellis*, Corall. 46, no. 1, pl. xxiii. figs. a, A, B, C, D.

ESCHARA FISTULOSA, *Linn.* Syst. ed. 10 (1758), 804.

CELLULARIA SALICORNIA, *Pall.* Elench. 61.

TUBULARIA FISTULOSA, *Linn.* Syst. ed. 12 (1766-8), 1302.

FLUSTRA FISTULOSA, *Linn.* Faun. Suec. ii. 2234.

* 'The Atlantic,' by Sir C. Wyville Thomson, F.R.S., vol. i. p. 348.

- CELLARIA SALICORNIA, *Lamx.* Pol. cor. flex. 55; Exposit. Méth. 5: *Lamk.* Anim. s. V. ed. 2, ii. 176: *Blainv.* Actinol. 455, pl. lxxvii. fig. 1: *D'Orbigny*, Pal. Franç. Terr. Crét. v. 28.
- CELLARIA FARCIMINOIDES, *Ellis & Sol.* Zooph. 26.
- SALICORNARIA SALICORNIA, *Cuvier*, R. Anim. ed. 1, iv. 75.
- FARCIMIA FISTULOSA, *Flem.* Br. An. 534.
- SALICORNARIA DICHOTOMA, *Schweigger*, Handb. 428.
- SALICORNARIA FISTULOSA, *Templeton*, Mag. N. Hist. ix. 469.
- CELLARIA FISTULOSA, *S. V. Wood*, Ann. N. H. xiii. 17: *Smitt*, Krit. Fört., Cefv. K. Vetensk.-Ak. Förh. 1867, 362 and 386, pl. xx. figs. 18-20.
- FARCIMIA SALICORNIA, *Johnst.* Br. Zooph. ed. i. 295, pl. xxxvii. figs. 6, 7: *Couch*, Corn. Faun. part 3, 129, pl. xx. fig. 3.
- SALICORNARIA FARCIMINOIDES, *Johnst.* B. Z. ed. 2, 355, pl. lxvi. figs. 6, 7: *Busk*, B.M. Cat. i. 16, pl. lxiv. figs. 1-3, pl. lxv. fig. 5: *Reuss*, Foss. Bryoz. d. öst.-ung. Miocän, 3, pl. xii. figs. 3-13.
- GLAUCONOME MARGINATA*, *v. Münster* in Goldfuss's Petref. Germ. i. 100, pl. xxxvi. fig. 5.
- CELLARIA MARGINATA, *Reuss*, Wien. Tertiärbeck. 59, pl. vii. figs. 28, 29.
- VINCULARIA SUBMARGINATA, *D'Orb.* Pal. Fr. T. Crét. v. 60.
- VINCULARIA REUSSI, *D'Orb.* l. c. 60.
- SALICORNIA MARGINATA, *Stoliczka*, Foss. Bryoz. aus d. tert. Grünsandst. der Otakei-Bai, Auckland, 146.
- VINCULARIA MARGINATA, *Römer*, Pol. d. Norddeutsch. Tertiärgeb. 105.
- GLAUCONOME RHOMBIFERA, *v. Münster* in Goldfuss's Petref. Germ. i. 100, pl. iii. fig. 6.
- SALICORNARIA RHOMBIFERA, *Reuss*, Zur Fauna d. deutsch. Oberoligocän, ii. 15, pl. xiv. figs. 7-10.
- VINCULARIA RHOMBIFERA, *Römer*, l. c. 6.
- CELLARIA AFFINIS, *Reuss*, Sitzungsber d. k. Ak. d. Wiss. 1855, xviii. 259, pl. xi. fig. 106.

Zoarium dichotomously branched, internodes of moderate length, slender, cylindrical, slightly attenuated below. *Zoæcia* contiguous in the same line, lozenge-shaped or hexangular, or rounded above and truncate† below; area minutely pitted; orifice arched above, lower lip slightly curved inward, usually subcentral, sometimes placed about $\frac{1}{3}$ the length of the area from the top. *Avicularia* at the top of a cell, on a small transversely

* The remaining synonyms are given *vide* Reuss, who had a large acquaintance with fossil forms.

† "The shape of the cells is not always of a lozenge-figure: sometimes we find them arched at top, and sometimes of the shape of a coffin."—ELLIS.

oblong area; mandible shallow, rounded, directed upwards. *Ovarian opening* suborbicular.

Polypide with about 14 long tentacles.

HABITAT. On rocks, shells, Corallines, &c., from shallow to deep water.

LOCALITIES. Very generally distributed. From the Eddystone to the Lizard and Land's End, common (Couch): South Devon (Torbay, Salcombe, Brixham trawlers, &c.), abundant; Ilfracombe (T. H.): Hastings (Tumanowicz): Dublin and Belfast Bays (W. T.): coast of Antrim, 62 and 72 fathoms (Mr. W. Swanston): Northumberland, frequent in deep water (Alder): Lam-lash (Landsborough): St. Andrews, deep water (Dr. M'Intosh): Hebrides; Shetland, 40–70 fathoms (A. M. N.): 5 miles south-west of Mull of Galloway, 110–140 fathoms (Beechey), &c.

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Pallas): Adriatic, attached to Nullipores, mussel-shells, and stones by delicate fibres, common (Heller): Cigale, 30 fathoms (Grube): on the Falmouth and Lisbon cable, between N. lat. $47^{\circ} 58'$ and $47^{\circ} 35'$, and in W. long. $7^{\circ} 6'$, at depths from 89–205 fathoms (Sir James Anderson): Algiers (J. Y. J.): Madeira (*vide* Kirchenpauer); Algoa Bay (Busk): New Zealand (Hutton): Australia (MacGillivray): Indian Ocean (Lamouroux): Norway (Sars): Bahusia, forma *fragilis* (Lovén): “ad insulas Waderöarne” (Goës): St. George's Banks, 28 and 60 fathoms (Smith and Harger).

RANGE IN TIME. Austro-Hungarian Miocene (Reuss).

Cellaria fistulosa exhibits the same variations in the shape of the cell as occur in the following species. It is slender in habit; and its internodes are generally much shorter than those of *C. sinuosa*. The normal position of

the aperture seems to be central or subcentral ; but cases occur in which it is placed much nearer the top of the area. It wants the raised and prominent lower lip of the latter species. The avicularium, with its very shallow arcuate mandible, directed upwards, is alone sufficient to distinguish it from the other British forms.

I have restored Linnæus's specific name, on the simple ground of its priority. Dr. Johnston summarily displaces it for its "impropriety," and because the retention of it would only tend "to the perpetuation of error." Of course, we are well aware now that the branches are not tubular ; but if we were to proceed to abolish all the names which represent an error in theory or observation, we should have our hands full, and should certainly inflict an injury upon science, for which a more strictly correct nomenclature would be poor compensation.

I have noticed two interesting monstrosities or irregularities of development in this species :—a doubling of the avicularium, two of smaller size occupying the place which is usually filled by one ; and ankylosis of the joint. The latter has been observed by Busk in *C. malvinensis*, and more frequently in the fossil species.

CELLARIA SINUOSA, Hassall.

Plate XIII. figs. 5–8.

FARCIMIA SINUOSA, *Hassall*, Ann. N. H. vi. 172, pl. vi. figs. 1, 2.

FARCIMIA SPATHULOSA, *Hassall*, *ibid.* xi. 112.

SALICORNARIA SINUOSA, *Johnst.* B. Z. (2 ed.) i. 356, pl. lxvi. fig. 8: *Busk*,
Crag Pol. 23: *Alder*, North. & Durh. Cat., Trans. Tynes. F.
Club, iii. 152 (62 sep.).

SALICORNARIA FARCIMINOIDES, var., *Busk*, B.M. Cat. pt. i. 17: ? *Manzoni*, Bry.
Foss. Ital. pt. iv. 4, pl. i. figs. 1, 2*.

* I have little doubt that Manzoni's figures should be referred to this species, and not to *C. fistulosa*. The position of the aperture in the upper part of

Zoarium dichotomously branched, internodes long and stout, cylindrical, slightly thickened towards the top, the extremities rounded. *Zoæcia* lozenge-shaped or hexagonal, or arched above and tapering off below; area finely dotted, walls minutely granular; orifice arched above, placed almost at the top of the area, with a much-raised lower lip, which forms a broad and prominent plate in front. *Avicularia* at the top of a cell, often set obliquely, with a triangular mandible pointing downwards. *Ovarian opening* at the very top of the area, elongated transversely, with a broad tooth on the lower margin.

HABITAT. Attached to stones, &c., from deep water and the Coralline ground to shallow water.

LOCALITIES. Belfast and Dublin Bays (W. T.) : South Devon; abundant on the Brixham trawling-grounds; Salcombe Bay, &c.; Cornwall (T. H.) : Northumberland, off Whitburn, in about 20 fathoms (Alder) : Shetland, 40–70 fathoms (A. M. N.).

RANGE IN TIME. Crag (Busk) : Italian Pliocene; Quaternary, Livorno (Manzoni) : near Mt. Gambier, South Australia, in Tertiary strata corresponding to the English Crag (Rev. J. E. Woods).

The characters which distinguish this species from the preceding are the much stouter habit and larger size, the shape of the avicularium, the position of the aperture in the upper part of the area and its raised and prominent lower lip, and the form of the ovarian opening.

the area, and its produced lower lip, and the shape of the ovarian and avicularian openings are all distinctive features of the present form. The author seems to have formed an imperfect conception of the group of characters by which *C. sinuosa* is distinguished from the last named species; for he speaks of it as a very trifling variety ("una ben leggera var. di *S. farciminoides*"). In point of fact they differ in almost every important element of structure, as well as in habit.

The mere shape of the cells is of little moment, as they exhibit marked varieties of pattern on the same specimen, being sometimes rhomboidal, and sometimes arched above, and sometimes almost quadrangular. There are also great differences in the number of the rows of cells composing the cylinder.

The avicularia are commonly placed obliquely; but in some cases the broad triangular mandible points straight downwards; they occur in larger numbers than on *C. fistulosa*. The ovarian opening is pierced, as it were, in the wall, at the upper extremity of the cell, just above the orifice. On its lower margin there is sometimes to be seen a broad denticle; but it is either often absent or is difficult to detect. Busk represents it as bicuspid; it may be so at times; but as I have met with it it has a perfectly plain straight top.

The shoots are attached by a mass of tubular fibres, each of which originates within the area of a cell, towards the base of it; they frequently cover the lowest internode. The tubes are simple, often of considerable length, and give off short processes at the extremity, which form a rude kind of adherent disk.

This handsome species grows in large tufts, from 3 to 4 inches in height, or even more.

The distinction between *C. sinuosa* and *C. fistulosa* has been so imperfectly appreciated that localities for the present form must be accepted with caution. I have only given those which seem to be beyond question. It has no doubt a more general distribution than these would indicate.

CELLARIA JOHNSONI, Busk.

Plate XIII. figs. 9-12.

NELLIA JOHNSONI, *Busk*, Quart. Journ. Micr. Sc. vi. (1858), 125, pl. xix. fig. 2
[described from imperfect specimens].

CELLARIA JOHNSONI, *Busk*, *ibid.* vii. 65, pl. xxiii. figs. 4, 5; pl. xxviii.
figs. 4, 5 (nat. size and avicularium).

SALICORNARIA JOHNSONI, *Busk*, *ibid.* viii. (1860), 280.

Zoarium slender, dichotomously branched, forming small white tufts, about 1 to 1½ inch in height. *Zoæcia* elliptical, distant, the space between them traversed by a ridge, which divides above into two lateral branches, passing off one on each side to the top of the adjacent cells; area smooth, walls very finely crenulated along the edge: orifice placed above the middle of the cell, arched above, lower margin slightly curved inwards. *Avicularium* situated in the line of the cells, and occupying the place of a cell; mandible semicircular, directed upwards. *Ovarian opening* orbicular.

HABITAT. Deep water.

LOCALITY. Shetland, Middle Haaf (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Madeira; Algiers (J. Y. J.).

The habit of this species is decidedly slender; but in this respect some varieties of *C. fistulosa* make a near approach to it. The principal distinctive characters are the elliptical or subelliptical form of the front of the cells, the interspace by which they are separated from one another, with its central bifurcating ridge, and the avicularium, which replaces an ordinary zoæcium. The mandible occupies the position of the oral valve, on an area resembling that of the cell, but smaller in size. It is large, semicircular, and of a dark horn-colour.

This simple type of avicularium is common amongst the members of this genus*.

The aperture is placed above the middle of the cell, and therefore rather higher up than in *C. fistulosa*. The cells in the same series are separated by a very considerable space. In the older portions of the zoarium the ridge which traverses it is often inconspicuous or nearly obliterated; but it may always be traced in the younger parts of the colony, towards the extremity of the cylindrical internodes.

Family VII.—Flustridæ.

ESCHARIDÆ (part.), Johnst. B. Z.: D'Orbigny, Pal. Franç.

FLUSTRADÆ (part.), Busk.

FLUSTRIDÆ, Smitt.

ZOARIUM *corneous and flexible*†, *expanded, foliaceous, erect*.

ZOÆCIA *contiguous, multiserial*. AVICULARIA *usually of a very simple type*.

CLOSELY allied to the *Membraniporidæ*, the *Flustridæ* are distinguished by their erect, flexible, and frond-like zoaria. The two families are certainly not very sharply defined. In its primary stage, *Flustra* sometimes takes on the *Membraniporidan* mode of growth; whilst, on the other hand, *Membranipora* in some cases (e. g. *M. flustroides* and *M. cornigera*) exhibits the type of avicu-

* In this less highly specialized form of avicularium all the parts of the cell are distinctly represented. The area with its inclosing walls is present, though reduced in size; the mandible is simply the oral operculum, enlarged, and raised by the hood-like elevation of the beak behind it.

† A certain amount of calcareous matter is combined with the horny substance of the zoarium.

larium which is usual (though not universal) amongst the *Flustridæ**. Still the general features of the group are sufficiently salient and striking, and its boundary lines probably not more evanescent than those of most of our systematic divisions.

Genus FLUSTRA, *Linnæus*.

Der. *Flustrian* (Saxon), to weave.

ESCHARA (part.), Pallas : Linn. Syst. ed. 10.

FLUSTRA, sp., Linnæus : Lamk. : Johnst. (part.) : Busk : Smitt (part.), &c.

CHARTELLA, Gray (for *F. papyracea*, &c.).

CARBASEA, Gray : Busk (? part.).

SEMIFLUSTRA, sp., D'Orbigny.

GENERIC CHARACTER.—ZOARIUM *erect, frondose*. ZOÆCIA *disposed in a single layer, or in two layers united by the dorsal surfaces, more or less quadrangular or linguiform, with a raised margin, the aperture occupying the whole or a considerable portion of the front of the cell, and closed in by a membranous covering*. OÆCIA *immersed*.

THIS genus, as now defined, includes species with two layers of cells, and others with only a single layer. The latter have been detached by some writers, and ranged under the genus *Carbasea*, Gray; but, so long as the type of the zoæcium is the same, it seems to me quite unnecessary to separate the bilamellate and unilamellate forms. It may be a question, perhaps, whether those members of the genus *Carbasea*, Busk, in which the aperture is reduced to a small opening at the upper extremity of the cell, and the ovicells are external, should

* The South-African form *Carbasea armata*, Busk, is furnished with lateral avicularia resembling those of *Scrupocellaria*.

not be referred to a distinct group—a point which can only be settled after a careful study of these forms. But all the British *Flustridæ* may be included in the present genus.

The polypide of *Flustra* exhibits no structural peculiarities.

The avicularia occur in most cases under a very rudimentary form. They are usually developed in the line of the cells, from which, indeed, they differ but slightly. Nowhere is the morphological significance of these curious appendages more easily recognizable.

This genus ranges to the Arctic regions and the northern coasts of America (Gulf of St. Lawrence), and is represented in the Mediterranean, in South Africa, in New Zealand and Australia; and in China and the Society Islands by *F. foliacea*. Of the Arctic species three (*F. serrulata*, Busk, *F. membranaceo-truncata*, Smitt, and *F. securifrons*, Pallas) occur in the Gulf of St. Lawrence; and two (*F. carbasea* and *F. securifrons*) are also British, but confined to our more northerly coasts. The genus has its principal seat in Europe, and is most abundant and most richly represented in northern latitudes.

a. *Zoëcia in two layers.*

FLUSTRA FOLIACEA, Linnæus.

Plate XVI. figs. 1, 1 a, 1 b; and Plate XIV. fig. 10.

PORUS CERVINUS, *Jussieu*, Mém. de l'Acad. Roy. d. Sc. 1742, 290, figs. 3, A, B, c c.

BROAD-LEAVED HORNWRACK, *Ellis*, Corall. 70, no. 2, pl. xix. fig. a, A.

ESCHARA FOLIACEA, *Linn.* Syst. ed. 10, 804: *Pallas*, Elenchus, 52: *Moll*, Eschara, &c. 44, pl. ii. fig. 7.

FLUSTRA FOLIACEA, *Linn.* Syst. ed. 12, 1300: *Ell. & Sol.* Zooph. 12. pl. ii. fig. 8: *Van Ben*, Recherches, 56, pl. vii. figs. 11, 17: *Lamk.*

An. s. Vert. ed. 2, ii. 219: *Grant*, Ed. New Phil. Journ. iii. 111, 337: *Flem.* Brit. An. 535: *Couch*, Corn. Faun. iii. 121, pl. xxi. fig. 1: *Johnst.* Brit. Zooph. ed. 2, 342, pl. lxii. figs. 1, 2: *Busk*, B.M. Cat. pt. i. 47, pl. lv. figs. 4, 5, pl. lvi. fig. 5: *Smitt*, Kritisk Förteckn., Öfvers. K. Vet.-Akad. Förh. 1867, 360 and 381, pl. xx. figs. 12-16.

Zoarium of a brown colour*, deeply divided into numerous multifid segments, which are narrowed towards the base, and expand upwards, generally bifid at the extremities, and slightly rounded. *Zoecia* in semi-alternating rows, arched and expanded above, with two spines on each side, and frequently one in the centre of the upper margin; below contracted and truncate; *avicularia* scattered, with semicircular mandible. *Oecia* extremely shallow, the opening forming an arch over the upper extremity of the cell.

Polypide with 13 or 14 remarkably long and slender tentacles.

Height of fine specimens about 6 inches.

HABITAT. On stones, shells, &c., generally in moderate depths, but also in much deeper water (62-70 fathoms).

LOCALITIES. Universally distributed on our coasts.

GEOGRAPHICAL DISTRIBUTION. Belgium, exceedingly common (Van. Ben.): coast of Normandy (Jussieu): Lissa, Adriatic (Heller): Charente-inférieure, "common at great depths" (Beltrémieux): south-west coast of France, very rare (Fischer): Society Islands (E. Forbes): Algoa Bay, a form only distinguished from the European by the comparative smallness of the cells; Amoy, China (Kirchenpauer): Norway (Smitt)†: the Belt and Kattegat (Kirchenpauer).

The frond-like shoots of *F. foliacea* rise from an in-

* "Yellowish grey," *Grant*; "of a lively flesh colour," *Couch*.

† It seems not to be an Arctic species; it has not been found, according to Smitt, in Finmark or Spitzbergen. There can be no doubt that the *F. foliacea* of Fabricius is a totally different form.

crusting network of cells, often of considerable extent, which bears a close resemblance to a *Membranipora*. On this crustaceous base they are crowded together, so as to form large clustered growths. The nascent shoots are wedge-shaped. The species is liable to many varieties of habit. In some cases the fronds are broadly palmate, and the segments into which they divide are much elongated, and expand regularly upwards from the slender base, terminating above in a broad, somewhat truncate extremity. In the more usual form the fronds are comparatively slender, the segments shorter and often bifid at the top. Occasionally specimens occur in which the frond is semi-elliptical, with the margin almost entire or slightly sinuated*, and with a distinct border, formed by a line traversing it from side to side, at a short distance from the edge and running parallel to it. (Plate XIV. fig. 10). When examined with the microscope the margin of the zoëcia is seen to be very minutely beaded. The polypides of this species are of very large size as compared with their cells; and the body is therefore very much bent and folded upon itself during retraction.

Much has been written of the scent of *F. foliacea*. When freshly taken from the water it has a decided perfume, not unlike that of the violet†; but it would seem to affect different persons very variously. Dr. Landsborough found its scent like bergamot, or, rather, like that of *Verbena triphylla*. It reminded Pallas of the citron‡; others have compared it to “the mixed

* “Broadening out towards the extremities, so as to present the outline of *Padina pavonia*.”—WM. THOMPSON.

† “A strong and pleasant odour of violets.”—GRANT. “An odour resembling that of violets after a shower.”—COUCH.

‡ “Recens e mari extracta amœnum, citri fere æmulum, cum pelagico mixtum odorem spargit; quem et siccata aliquamdiu servat.”—*Elenchus Zoophyt.* p. 54.

odour of roses and geraniums ;” whilst Ellis bluntly calls it “ fishy.”

The flat frond of *F. foliacea** offers an excellent site for the colonies of the smaller Polyzoa and Hydroida ; and many species are commonly found associated with it—amongst the rest, *Scrupocellaria reptans* and *S. scruposa*, *Crisia eburnea*, *Bugula flabellata*, *Sertularella rugosa*, &c.

The rare and interesting Hydroid *Hydranthea margarica*, Hincks, would seem to have no other habitat ; and in the only known locality for it, the shallow water off the Capstone at Ilfracombe, almost every tuft of the *Flustra* which comes up in the dredge is covered with its delicate network and flower-like polypites.

Sir John Dalyell has studied the embryos, and states that he has known ten thousand to be liberated from a specimen in the course of three hours !

This species is one of the commonest of sea-side objects, and may generally be met with on any sandy beach.

FLUSTRA PAPYRACEA, Ellis and Solander.

Plate XVI. figs. 2, 2 a.

FLUSTRA PAPYRACEA, *Ell. & Sol.* Zooph. 13: *Fleming*, Brit. An. 535: *Busk* B.M. Cat. i. 48, pl. lv. figs. 6, 7: *Hincks*, Dev. & Corn. Cat 37+.

FLUSTRA CHARTACEA, *Turt.* Gmel. iv. 663: *Couch*, Corn. Faun. iii. 121: *Johnst.* Brit. Zooph. ed. 2, 343, pl. lx. figs. 5, 6.

CHARTELLA PAPYRACEA, *Gray*, Cat. Rad. B. M. 104.

Zoarium forming small bushy tufts of a light straw-colour, much divided dichotomously, the segments short and

* . . . “telam sericeam texturâ æmulans.”—*Plukenet*.

† *Flustra papyracea* of *Hutton's Catalogue of New Zealand Polyzoa* must be a totally different form. He describes it as having fusiform avicularia “situated on the right or left marginal spine.”

rather narrow, expanded at the summit, truncate or slightly rounded. *Zoæcia* oblong, with a single short spine at each side above. *Oæcia* small, galeriform, somewhat produced. *Avicularia* none (?).

Height of tufts about $1\frac{1}{2}$ inch.

HABITAT. On stones, shells, &c., generally in very moderate depths.

LOCALITIES. South Devon, not uncommon; Salcombe Bay; Plymouth; Torbay; Ilfracombe, 8-10 fathoms (T. H.): Cornwall, very rare, on shell from deep water 8 leagues south of the Deadman (Couch): Tenby (F. Walker): Hastings (Ellis): Brighton (Lister): east and south of Ireland (W. T. & Allman).

GEOGRAPHICAL DISTRIBUTION. Roscoff, very rare (Joliet): Charente-Inférieure, pretty common (Beltrémieux): west coast of France (Fischer)*.

This pretty species is distinguished by its small size, its bushy habit of growth, and the delicacy of its texture. The zoarium has a varnished and glistening appearance; the segments into which the fronds divide are short and subtruncate. *Avicularia* seem to be altogether wanting. It is limited in its range, and has probably not occurred in the north.

The oœcium is placed very far back, and projects into the cell above it, being completely roofed over by its front wall. The arch across the orifice is slightly raised; but the rest of the ovicell is completely immersed, and

* Kirchenpauer records this form from Hougessund, and Lütken from Greenland; but these localities are extremely doubtful. Kirchenpauer's species is probably not identical with our *F. papyracea*; for he remarks that it had not its thin papyraceous character. And as we have no other record of the occurrence of the present species in the north, and especially as it does not appear amongst the 'Valorous' dredgings, or those of the North-German Polar Expedition, I venture to think that Lütken must be in error in assigning it to Greenland.

the mere outline is traceable through the membranous covering. The aperture of the ovicell is closed in by a delicate membrane; and at the top of it there is frequently an opening of definite form, which probably gives egress to the mature embryo.

FLUSTRA SECURIFRONS, Pallas.

Plate XVI. figs. 3, 3 a.

"NARROW-LEAVED HORNWRACK," *Ellis*, Corall. 69, no. 1, pl. xxviii. fig. 1, a, A, B.

ESCHARA FOLIACEA β , *Linn.* Syst. ed. 10, 804.

ESCHARA SECURIFRONS, *Pallas*, Elench. (1766), 56.

FLUSTRA TRUNCATA, *Linn.* Syst. ed. 12, 1300: *Lamk.* An. s. Vert. ed. 2, ii. 219: *Flem.* B. An. 535: *Johnst.* Br. Zooph. ed. 2, 344, pl. lxii. figs. 3, 4: *Busk*, B.M. Cat. i. 48, pl. lviii. figs. 1, 2, and pl. lvi. figs. 1, 2.

FLUSTRA PAPIRACEA, *Dalyell*, Rem. An. ii. 19, pls. v., vi., and vii. (var.).

CHARTELLA SECURIFRONS, *Gray*, Cat. Rad. B. M. 104.

FLUSTRA SECURIFRONS, *Smitt*, Krit. Förteckn., Öfv. K. Vet. Ak. Förh. 1867, 358 and 378, pl. xx. figs. 6-8.

Zoarium bright straw-coloured, divided and subdivided into narrow segments, which are linear or slightly dilated above, and truncate, rooted by many tubular fibres. *Zoecia* linear, oblong, with unarmed margins. *Avicularia* scattered, elliptical, with a rounded mandible. *Ozecia* globose, with a slightly thickened rim in front, the lower part of the aperture closed in by two rib-like processes.

Height 4 or 5 inches.

HABITAT. On shells, &c. from the Laminarian region and the Coralline ground.

LOCALITIES. Chiefly a northern form. Shetland (A. M. N.): Scotland, common (Johnst.): Peterhead, abundant (C. W. P.): St. Andrews, Laminarian and Coralline zones, common (Dr. M'Intosh): Leith; Dirleton, opposite

the Bass Rock (Landsb.): Oban (T. H.): Firth of Forth, 30 fathoms (Kirchenpauer): Northumberland and Durham, abundant (Alder): two miles east of Sana Island, in 40 fathoms (Hyndman): 8 miles S.S.W. Mull of Galloway (Capt. Beechey): Filey, plentiful (T. H.): Dublin Bay (Templeton): Belfast Bay (W. T.): coast of Antrim, 20 fathoms (Mr. W. Swanston).

Var. (*papyracea*, Dalyell) "with the ends expanded into undulating foliations, from the fusion of several of the terminal branchlets into one." Scotland (Dalyell): Northumberland (Alder).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Pallas): Adriatic (Heller): Lofoten; near Tromsö and Havösund, in 40-50 fathoms, rare (M. Sars): Spitzbergen; western coast of Skandinavia, 10-50 fathoms (Smitt): *ibid.* 150-300 fms. (Koren): South Labrador, frequent (Packard).

This species forms very large bunches, of a light straw-colour when fresh.

In many specimens "wedge-shaped leaflets" are developed along the edges of the segments composing the zoarium.

The ovicell, as in all the species of this genus, is inclosed within the walls of the cell above it, and overlaid with its membranous covering, so as to be quite inconspicuous. Indeed, the ovicell itself is all but invisible; the arch in front of it and the aperture are the only signs of its existence which strike the eye. The latter is filled in by a membrane, and is also protected by two rib-like appendages, which are given off one on each side of it, and meet in the centre. The oecium of this species is larger and more fully developed than that of *Flustra foliacea* (woodcut, fig. 6).

Fig 6.



Oecium.



I have followed Gray and Smitt in substituting Pallas's name for that of Linnæus. The publication of the 12th edition of the 'Systema,' in which the present form first received the name *truncata*, commenced in 1766, the date of the appearance of the 'Elenchus;' but the work was not completed till 1768, and it is in the volume bearing date 1767 that the name occurs. Pallas, therefore, has undoubted precedence; and it becomes a pleasant duty to associate this fine species with the name of one of the most sagacious and accurate of observers.

FLUSTRA BARLEEI, Busk.

Plate V. figs. 6-8.

FLUSTRA BARLEEI, Busk, Quart. Journ. Micr. Sc. viii. (1860), 123, pl. xxv. fig. 4.

Zoarium foliaceous, thin and brittle, light-coloured, divided, the segments above terminating in short rounded lobes. *Zoæcia* oblong, very large, with a simple margin. *Avicularia* scattered, placed obliquely, with a semi-circular mandible. *Oæcia* globose and rather shallow. Height of fine specimens about 2 inches.

HABITAT. In moderately deep water.

LOCALITIES. Shetland (Barlee): "very local, between Whalsey and Balta, and off Unst, in about 50 fathoms" (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Entrance to the Bömmel-Fjord, in 106 fathoms (Kirchenpauer).

This species is distinguished by its very large, rectangular cells, with an unarmed margin, by the oblique position of the avicularia, and by its habit of growth. It

consists of foliaceous fronds, which divide near the base into segments; these again subdivide, and at the top are cut into shallow blunt lobes. The habit is neat and compact. When dry the zoarium has a varnished appearance. There is nothing very distinctive in the character of the oecium; it is globose in form, moderately shallow, with a large aperture, completely filled in by a membranous covering, the arch of which alone rises above the surface of the zoarium. The immediate cause of the immersion of the ovicell is at once apparent in the case of cells from which the front wall has disappeared. It is then evident that the *top wall of the zoecium, to which the ovicell is attached*, is considerably lower than the side walls, which support the roofing. The consequence is, that when fully developed the ovicell is still below the surface, inclosed by the sides of the cell above it, and concealed by its membranous covering.

This is one of the many forms which we owe to Mr. Barlee's assiduous labours as a dredger.

b. *Zoecia in a single layer.*

FLUSTRA CARBASEA, Ellis and Solander.

Plate XVI. figs. 4, 4 a, and Plate XIV. fig. 1.

FLUSTRA CARBASEA (Lawn Sea-mat), *Ell. & Sol. Zooph.* xiv. pl. iii. figs. 6, 7: *Lamk. An. s. Vert.* ed. 2, ii. 221: *Flem. B. A.* 535: *Grant, Ed. N. P. Journ.* iii. 111: *Dalyell, Rem. An. Scotl.* ii. 3, pls. i. & ii.: *Johnst. B. Z.* ed. 2, 345, pl. lxiii. figs. 1, 2: *Kirchenpauer, Bericht. ü. d. Untersuchungs-Fahrt d. 'Pomerania,'* 177, 178.

CARBASEA PAPYRACEA, *Gray, Cat. Rad. B. M.* 103.

CARBASEA PAPYREA, *Busk, B.M. Cat.* i. 50, pl. xlix. figs. 1, 2, 3: *Alder, North. & Durh. Cat.* 61.

SEMIFLUSTRA CARBASEA, *D'Orb.* Pal. Franç. Terr. Crét. v. 326.

FLUSTRA PAPYREA, *Smitt*, Krit. Fört., Öfv. &c. 1867, 359 and 380, pl. xx.
figs. 9-11 (not *Eschara papyrea*, Pallas) *.

Zoarium frondose, attached by a small disk, narrowed below, with a thickened margin towards the base, expanding upwards, deeply divided into segments, which again subdivide, and terminate in somewhat broad and rounded lobes; of a yellowish brown colour, and thin, delicate, papyraceous texture. *Zoæcia* on one side only, large, often much elongated, arched above, contracted below, and truncate at the bottom (linguiform).

Avicularia none. *Oæcia* none.

Polypide with about 22 tentacles.

Height 2-4 inches.

HABITAT. On stone and shell from rather deep water.

LOCALITIES. Shetland, fishing-boats, Middle Haaf (A. M. N.): Peterhead, rare (C. W. P.): Aberdeen (Skene): St. Andrews, after storms and from the fishing-nets, not abundant (Dr. M'Intosh): Leith (Dr. Coldstream): oyster-beds, Firth of Forth (Grant): Berwick (Johnst.): Newhaven, fishermen's nets (Dr. Landsb.):

* Kirchenpauer, in his Report on the North-Sea Polyzoa obtained during the voyage of the 'Pommerania' (1875), proposes to separate the *Eschara papyrea*, Pallas (*Flustra papyracea*, Linn.), from the *Flustra carbacea* of Ellis and Solander, on the ground (chiefly) that the cells of the former are described as "rhombic" whilst those of the latter are "linguiform." He regards Pallas's species as a Mediterranean form, distinct from our British species, which is undoubtedly the *Flustra carbacea* of Solander. I am inclined to believe that this view is correct. Pallas is singularly accurate in his descriptions, and would have been little likely to characterize the strongly marked cells of *F. carbacea* as rhombic, a term which is in no sense applicable to them. They are, as Linnæus describes them, "*supra ovata, medio angustata, infra truncata*." Pallas also makes no mention in his description, as Kirchenpauer has remarked, of the thickened margin of the zoarium towards the base, which is so peculiar and striking a feature of the latter form, an omission which we should not have expected from the author of the 'Elenchus.'

It must be admitted, at the same time, that in most respects his description agrees with the present species. Linnæus recognized the two forms as

Northumberland, deep water, frequent (Alder): Filey, abundant (T. H.): Bootle, rare (Tudor): Dublin Bay, rare (M'Calla): North of Ireland (Templeton).

GEOGRAPHICAL DISTRIBUTION. Hammerfæst, 40 fathoms, on a stony bottom; Ramfjord, near Tromsø (Sars): Bohuslän (Lovén): Spitzbergen, 40-60 fathoms (Torell): Greenland (Lütken): Gulf of St. Lawrence (Dawson).

This species is not attached by means of radical fibres; nor does it rise from an expanded crust. The zoarium narrows towards the base into a kind of stem, terminating below in a small disk, by which it adheres to stone or shell. The lower portion or trunk has a thickened, opaque, and channelled margin. The terminal segments of the frond are broad and wedge-shaped, and generally more or less lobate; and the width of the whole zoarium is great as compared with its height. A variety occurs in which the shoots are composed of broadly palmate expansions, sometimes almost entire, sometimes with numerous marginal lobes. The texture is remarkably delicate (like that of lawn, according to Ellis); and the

distinct. On the whole I think we are fairly entitled to say that we should not be justified in setting aside the diagnosis of so careful an observer as Pallas, and implying that he had failed to appreciate an important character. It may be added that he gives no British locality for his *Eschara papyrea*.

Kirchenpauer also considers Smitt's *Flustra papyrea* a distinct species, on the ground that this author has not stated that it has only a single layer of cells, and that it must therefore be regarded as bilaminar. But though he has not expressly referred to this character in the text, he has figured the posterior surface of the frond, showing the back of the cells (Krit. Förtekn. pt. iii. pl. xx. fig. 10.), while at the same time he has placed amongst his synonyms *Carbasea papyrea*, Busk, and other names, which he must have known were appropriated to a unilamellate form. His figure 9 is an accurate representation of the cells of *Flustra papyrea*; and in his descriptive text he has noticed several of its distinctive peculiarities. There is no ground whatever for separating his species from the present.

surface glistens when dried. The cells are arranged with extreme regularity, and form a pretty and distinct lace-work pattern on the frond. The structure is eminently simple; spines, avicularia, and probably oœcia, are all wanting. Grant describes the development of the ovum, which is of a light-yellow colour, and its escape from the cell itself into the water.

Family VIII.—Membraniporidæ.

CELLEPORIDÆ (part.), Johnston, Brit. Zooph.

MEMBRANIPORIDÆ (part.), Busk, B.M. Cat.

FLUSTRELLARIDÆ (part.), D'Orbigny, Pal. Franç. T. Crét.

ESCHARIDÆ (part.), id. ibid.

ESCHARELLINIDÆ (part.), id. ibid.

FLUSTRELLIDÆ (part.), id. ibid.

FLUSTRINIDÆ (part.), id. ibid.

ELECTRINIDÆ (part.), id. ibid.

MEMBRANIPORIDÆ, Smitt, Krit. Förteckn.

*ZOARIUM calcareous or membrano-calcareous, incrusting (so far as British species are concerned) *. ZOÆCIA forming an irregular continuous expansion, or in linear series, with raised margins, and more or less membranaceous in front.*

THIS family represents an earlier stage of zoœcial development, as compared with the two following. The calcification of the cell is always more or less imperfect; and in a large proportion of cases the whole of the front is merely closed in by a membrane, a condition which we meet with in the immature cells of the old Lepralian group.

* There are fossil and other forms with an erect habit of growth, which from the structure of their zoœcia, should probably be included in this family.

The avicularia in this family almost always exhibit a more highly specialized form than in the preceding. They are usually secondary formations, borne upon the zoëcia instead of being developed in the same plane with them.

In a great proportion of cases the colonies in the present family, and indeed very commonly amongst the Cheilostomata at large, originate in a peculiarly shaped cell, which differs widely from the mature zoëcium. And these primary cells exhibit, with minor differences, a general similarity of structure. They are for the most part somewhat rounded, with a large terminal aperture, closed in by a membrane, and usually surrounded by a number of spines. Such a form was long since described by Van Beneden as a distinct genus, under the name of *Tata**; and the original cell of the Cheilostomatous colony is often distinguished as the *Tata*-form. Of course this genus, being founded on an early and immature condition, which is common to a large section of the Polyzoa, has not been maintained. I have designated the first element of the Cheilostomatous colony the *primary cell*; and if a separate name is needed for the form which it generally assumes, it may be styled the *Tata*-stage.

Genus MEMBRANIPORA, *Blainville*.

Der. From *membrana*, a thin skin, and *porus*, an opening.

ESCHARA (part.), Pallas.

FLUSTRA (part.), Linn. : Lamarck : Fleming : Lamouroux : Audouin.

MEMBRANIPORA, Blainville, Man. d'Actinol. : Johnston : Busk : Smitt : &c.

DISCOPORA (part.), Lamk. An. s. V.

* "Recherches sur les Pol. Bryozoaires de la mer du Nord," Bull. Ac. Roy. Belg. xvi. no. 12 (1849), p. 6 (sep.).

CELLEPORA (part.), Hagenow : Reuss : D'Orbigny * (for species with a calcareous lamina).

ANNULIPORA (sp.), Gray, B.M. Rad. Append.

CONOPEUM (sp.), Gray, id. ibid.

CALLOPORA (sp.), Gray, id. ibid.

AMPHIBLESTRUM (sp.), Gray, id. ibid.

MARGINARIA (part.), Rømer : Hagenow.

DERMATOPORA (part.), Hagenow.

GENERIC CHARACTER.—ZOARIUM *incrusting*. ZOÆCIA *quincuncial, or irregularly disposed, occasionally in linear series ; margins raised ; front depressed, wholly or in part membranaceous*.

THE essential characters of this division are the raised margin, and the depressed front wall of the zoæcium, which is always more or less membranaceous. The orifice is merely an opening in the membranous portion of the covering, closed in by an opercular valve, and is never surrounded and isolated by a calcareous border. In the most typical forms, such as *M. membranacea* and *M. Lacroixii*, the entire area of the zoæcium is covered uniformly by a thin membrane, which lies a little below the level of the margin. In others this membrane is calcified to a greater or less extent, and a solid lamina is thus formed, which protects a certain portion of the cell. But even in species in which this process of calcification is carried furthest, and almost the whole front is hardened into a solid wall, its position within and below the marginal rim at once indicates the mode of growth, and reveals the true Membraniporidan structure. The passage to the old Lepralian type is not through such forms, or through the genus *Micropora*, but through *Membraniporella*, in which the calcareous covering is an outgrowth

* I have not thought it necessary to swell this list of synonyms by referring to all D'Orbigny's genera, which include species of *Membranipora* as now defined. The groups to which they belong are given in the family synonymy.

from *the margin of the cell*, overarching, as it were, the original membranous covering.

The present genus may be divided into two principal groups—the first including those species in which the area is wholly roofed in by a chitinous membrane, and the second those in which the covering is converted, to a greater or less extent, into a solid plate.

It has been proposed to refer to a distinct genus certain forms with a trifoliate or subtrifoliate aperture, taking *M. Flemingii* as the type. But this character is rather a shadowy one, and the group thus constituted would not be sufficiently differentiated from other *Membraniporæ* with a calcareous lamina.

The terminology employed in describing the members of this genus requires a word of explanation. The *area* is the portion of the cell surrounded by the raised margin. The *aperture* is that part of it which is not closed in by a calcareous wall; and on this is placed the true orifice—a semicircular opening, with a valvular operculum. In the species which have the front wall wholly membranous, the area and the aperture of course coincide.

The genus *Membranipora*, as now limited, has a wide range both in space and time, and includes a rich variety of forms. It reaches back as far as the Cretaceous period at least, in which it was represented by a large number of species. It is found in almost all parts of the world.

a. *With a membranous front wall.*

MEMBRANIPORA LACROIXII, Audouin.

Plate XVII. figs. 5–8.

FLUSTRA LACROIXII, *Savigny*, Égypte, pl. x. fig. 9.

FLUSTRA DISTANS, *Hassall*, Ann. N. H. vii. (1841), 369.

FLUSTRA PEACHII, *Couch*, 9th Rep. Cornw. Polytechn. Soc. 81.

MEMBRANIPORA PEACHII, *Couch*, Corn. Faun. iii. 120, pl. xxii. fig. 13.

?MEMBRANIPORA MEMBRANACEA, *Johnst.* B. Z. 2 ed. pl. lvi. figs. 11, 12.

CONOPEUM RETICULUM, *Gray*, B.M. Rad. 108.

MEMBRANIPORA LACROIXII, *Busk*, B.M. Cat. ii. 60, pl. lxi., pl. civ. fig. 1:
Hincks, Dev. Cat., An. N. H. ser. 3, ix. 28 (38 sep.).

MEMBRANIPORA RETICULUM, *Reuss*, Foss. Polyp. d. Wiener Tertiärbeck. 98,
pl. xi. fig. 25.

BIFLUSTRA LACROIXII, *Smitt*, Flor. Bryoz. pt. ii. 18, pl. iv. figs. 85-88.

Zoæcia oval, sometimes much elongated, area occupying (usually) the whole of the front of the cell, with a membranous covering; or occasionally a calcareous expansion round the inner edge; margin slightly thickened, rounded, granulated, rising, so as sometimes to form a prominent ridge; often armed with two erect spines, one on each side above, more rarely bearing a considerable number (about eleven), very delicate and sharply pointed; frequently a triangular hollow on each side, immediately above the aperture. *Oæcia* none.

Colonies forming a thin gauze-like crust over shells and stones, often of great extent.

RANGE OF VARIATION. The front of the cell is either a very regular oval or much elongated and narrowed. It is generally occupied entirely by the aperture; but occasionally the zoæcium is slightly produced below. The cells lie very closely together in most cases; and specimens are rarely met with in which they are more or less disjunct. The spines vary in number from two to about a dozen. Usually they are represented by the couple at the top of the cell; but in sheltered situations the margin bristles with slender spinules, and in most colonies cells may be met with on which a few at least survive. The hollow triangular spaces above the aperture are often wanting. They are not true avicularia, but consist of a three-cornered area inclosed by calcareous walls, and covered in by a transparent membrane. This membrane is frequently destroyed; and they then appear as hollow

triangular structures, which bear a general resemblance to the pointed form of avicularium.

HABITAT. On stones and shells from tide-marks to deep water.

LOCALITIES. Cornwall, in Falmouth and Fowey rivers, on mussel- and oyster-shells; off the Deadman (Couch): South Devon, between tide-marks and from moderate depths, common; Ramsay, Isle of Man, on stones in tide-pools (T. H.): on stones east of Kingstown Harbour (Hassall): St. Andrews, on a valve of *Cyprina Islandica* from deep water (Dr. M'Intosh): Tynemouth, a single specimen (Alder): Hastings, common (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Savigny): coast of Florida, 13-60 fathoms (Pourtales): St. Lawrence (Whiteaves)*.

RANGE IN TIME. Coralline and Red Crag (part.) (Middle Pliocene); Palæolithic (A. Bell): Austro-Hungarian Miocene and Pliocene deposits; Vienna Basin (Reuss): Italian Pliocene beds at Volterra (Manzoni): Postpliocene (Dawson).

MEMBRANIPORA MONOSTACHYS, Busk.

Plate XVII. figs. 3, 4; Plate XVIII. figs. 1-4.

MEMBRANIPORA MONOSTACHYS, *Busk*, B.M. Cat. ii. 61, pl. lxx.; Crag Pol. 31, pl. ii. fig. 2: *Hincks*, Devon. Cat. 38 (sep.), Ann. N. H. ser. 3, ix. 28.

FLUSTRA DISTANS, *Landsb.* Pop. Hist. B. Z. 354 (not *F. distans*, Hassall).

MEMBRANIPORA PILOSA, 4, forma **MONOSTACHYS**, *Smitt*, Œfvers. K. Vet.-Ak. Förh. 1867, 370 and 416.

?**FLUSTRELLARIA PUSTULOSA**, *D'Orb.* Pal. Franç. Terr. Crét. v. 526, pl. dccxxv. figs. 22-25.

?**MEMBRANIPORA NOBILIS**, *Reuss*, Foss. Polyp. W. Tertiärb. 98, pl. xi. fig. 26.

* The *M. Lacroixii* of Packard's List of Labrador Invertebrata is referable, according to Smitt (who had seen a specimen forwarded by the above naturalist), to his *M. Americana*.

Zoæcia subovate, produced and attenuated below; area oval, more or less elongate, occupying about two thirds of the front of the cell, with a membranous covering; margins thin and plain, bearing a single acuminate spine below the aperture, bending inwards, and occasionally a tall and very slender erect spine on each side near the top, or armed with numerous delicate spines (about 18), the central one below being larger and stouter than the rest, and the two uppermost standing erect. *Zoarium* usually assuming a dendritic growth, giving off branches consisting of lines of cells two or three abreast, or in single series, which anastomose freely.

Var. *a* (*fossaria*). *Zoæcia* elongate-oval; area occupying the whole of the front of the cell; a single stout conical spine at the bottom. *Zoarium* spreading over the stems of plants in brackish water, and forming friable, irregularly shaped, sponge-like masses.

RANGE OF VARIATION. *M. monostachys* affords a striking illustration of the remarkable diversities in habit and general appearance that may rank under one and the same specific type. In its early condition it forms a continuous expansion, the cells being disposed in somewhat radiate fashion. But the zoarium does not long maintain this simple character; it is soon resolved, as it were, into lines of cells, in which two or three are ranged abreast; and these again give off single series, from which in time other compound series may originate; and so the ramification proceeds, until a large and complex and very beautiful dendritic growth is the result.

The differences in the number of the spines with which the margin of the cell is armed are also great, and they affect very materially the appearance of the species. The acuminate spine at the bottom of the area is tolerably constant; it is always present on some of the cells in a

colony. The two erect spines at the top of the cell are frequently associated with it, though very commonly absent. The lateral spines seem to be rarely developed. In a beautiful variety from Roach River, the branches are mostly uniserial, and the margin of the cells is clothed with about sixteen delicate spines, which bend inwards over the aperture. I have a similar variety from Torquay. Specimens of this form bear a curious general resemblance to *Hippothoa dentata*, Busk, a Crag species.

In the variety (*fossaria*), which occurs in brackish waters, the aperture is much elongated and occupies the whole, or nearly the whole, of the front of the cell. The produced pedunculate portion at the base has disappeared, and with it most of the characteristic *facies* of the species. There is a single stout conical spine at the lower extremity of the aperture. The cells seem to be composed of less-solid material than in the normal form; and, from the nature of the base over which it spreads, the zoarium assumes a peculiar habit.

HABITAT. On rocks between tide-marks; on shells and stones, chiefly at the mouths of rivers; and on the stems of water plants in brackish ditches.

LOCALITIES. Mouth of the river Deben, on the Suffolk coast, abundant (Busk): Roach River (J. G. Jeffreys): Torquay, on stone between tide-marks; Ilfracombe, on the Capstone rocks (T. H.): Hastings (Miss Jelly).

Var. a. Yarmouth, in ditches of brackish water, about a mile from the sea, on stems of aquatic plants (Mr. Wigham).

GEOGRAPHICAL DISTRIBUTION. "I have a specimen very like this species, from St. Vincent, one of the Cape de Verde Islands" (Busk): "minus expressam hanc formam ad Bahusiam vidi" (Smitt).

RANGE IN TIME. Red Crag, on shells (*Mactra*, *Mya*,

and *Purpura*) (Busk): Tertiary beds, Vienna Basin (Reuss)?

Mr. Busk assigns avicularia to *M. monostachys*; but as I have never met with them on any of the specimens from very various localities which I have examined, I have omitted the character. There are structures, however, scattered over the zoarium, which in some measure remind us of avicularia. These are dwarfed and imperfectly developed cells, which are interspersed in considerable numbers amongst the normal zoœcia. They are of small size, roundish, or miniature copies in shape of the ordinary cells, with a subcircular or oval aperture, which is covered in by a delicate membrane.

MEMBRANIPORA CATENULARIA, Jameson.

Plate XVII. figs. 1, 1 a, 2.

TUBIPORA CATENULARIA, *Jameson*, Wern. Mem. i. 561.

TUBIPORA CATENULATA, *Stewart*, Elem. ii. 425.

HIPPOTHOA CATENULARIA, *Flem.* B. A. 534: *Johnston*, Brit. Zooph. (ed. 2), i. 291, pl. 1. figs. 9, 10: *Busk*, B.M. Cat. i. 29, pl. xviii. figs. 1, 2.

HIPPOTHOA ELLIOTÆ, *Gray*, Zool. Misc. 34.

PYRIPORA RAMOSA, *D'Orb.* Pal. Franç. Terr. Crét. v. 539.

? HIPPOTHOA RUGOSA, *Stimpson*, Invert. Grand Manan, 18.

MEMBRANIPORA PILOSA, forma CATENULARIA (*M. catenularia*), part., *Smitt*, Kritisk Förteckn. iii., Öfvers. K. Vetensk.-Akad. Förhandl. 1867, 370 and 415, pl. xx. fig. 45.

Zoœcia contiguous, ovate above, more or less produced and narrowed below, linked together in linear series, from which branches are given off irregularly, frequently anastomosing, or massed together and coalescent; walls solid, smooth, or transversely wrinkled;

area, occupying the whole of the upper part of the cell, oblique, oval, slightly expanded below and contracted above, with a plain, rather wide and flat border. *Oæcia* none.

HABITAT. On shells, stones, Algæ (rarely), &c. from deep water.

LOCALITIES. Generally distributed. *Pinnæ*, off the Deadman and west to the Lizard (Couch) : South Devon, very common (T. H.) : Isle of Wight (W. T.) : St. Andrews, less common than *Hippothoa divaricata* (Dr. M'Intosh) : *Pinnæ*, I. of Coll (Landsb.) : Shetland, on stones, 40–170 fathoms ; The Minch (A. M. N.) : *Pinnæ*, coast of Cork ; co. Galway, on *Buccinum Zetlandicum* ; off the Gobbins, co. Antrim, 40 fathoms (W. T.) : off Mull of Cantire, 40 fathoms (Hyndman) : &c., &c.

GEOGRAPHICAL DISTRIBUTION. On mussels, Algæ, &c. Adriatic (Heller) : Naples (A. W. Waters) : Ile de Ré, France (D'Orbigny) : North Sea, “*extra Norvegiam*,” on *Gorgonia*, 200–300 fathoms (Baron Uggla) : Gulf of St. Lawrence (Dawson) : Labrador (Packard) : ? Grand Manan (Stimpson).

RANGE IN TIME. Palæolithic ; Red Crag (part.) ; Cor. Crag (A. Bell) : Scotch Glacial deposits (Geikie) : Post-pliocene deposits, Canada (Dawson) : Italian Pliocene, Calabria (Manzoni) : Pliocene of Bruccoli, Sicily (A. W. Waters).

M. catenularia has been ranked by most authors in the genus *Hippothoa* ; but its large aperture, occupying a great proportion of the front of the cell and closed in by a membranous covering, at the top of which the oral valve is placed, is a character which separates it from the other

members of that genus and allies it to the present. There is no essential distinction between *M. catenularia* and such a form as *M. monostachys*, which also takes on not unfrequently the characteristic habit of *Hippothoa*. There is, indeed, a difference in the mode of branching; but in a variety of *M. pilosa* figured by Smitt *, branches are given off from the sides of the cells and at right angles to them, in the most typical Hippothoan fashion; and therefore we cannot use this character as a diagnostic. In the present form the cell is more or less produced below, but there is no approach to the thread-like prolongation which distinguishes the true *Hippothoa*. I have no doubt that its proper place is amongst the *Membraniporæ*.

There is a great tendency in this species to the massing together of the cells, which often form a continuous expansion of considerable extent. In such cases the branch lines of cells, which are very numerous, take an upward direction, and are brought into close union, so as to constitute what seems to be a solid crust of somewhat fan-shaped figure. In other cases a different habit prevails, and the zoarium covers the shell, which it incrusts, with a very pretty dendritic pattern.

In many of the zoœcia the area is completely closed in by a solid calcareous covering. I have never met with the spine below the aperture, as figured by Smitt †, on any specimen which I could refer to this species.

* Krit. Förteckn. iii. pl. xx. fig. 49.

† Loc. cit. pl. xx. fig. 46.

MEMBRANIPORA PILOSA, Linnæus.

Plate XXIII. figs. 1-4.

IRREGULAR SPONGY FOLIACEOUS CORALLINE, *Ellis*, Corall. 73, no. 4, pl. xxxi. and pl. xxix. fig. D.

FLUSTRA PILOSA, *Linn.* Syst. ed. 12, 1301: *Ellis & Sol.* Zooph. 13: *Lamk.* An. s. Vert. ed. 2, ii. 224: *Grant*, Edinb. N. Phil. Journ. iii. 111: *Flem.* B. A. 537: *Lister*, Phil. Trans. 1834, 384, pl. xii. fig. 2.

ESCHARA PILOSA, *Pallas*, Elench. 50: *Moll*, Esch. 37, pl. ii.

FLUSTRA DENTATA, *Ell.* & *Sol.* Zooph. 15: *Müll.* Zool. Dan. iii. 24, pl. xcv. figs. 1, 2: *Lamk.* An. s. Vert. ed. 2, ii. 224.

FLUSTRA LINEATA, *Esper*, Pflanz. Flust. pl. vi.

MEMBRANIPORA PILOSA, *Farre*, Phil. Trans. 1837, 412, pl. xxvii. figs. 1-5: *Johnst.* B. Z. ed. 2, 327, pl. lvi. fig. 6: *Van Ben.* Recherch. 53, pl. vii. figs. 1-10; *Mém. Acad. Roy. Belg.* xviii. 29, pl. iv. figs. 1-10: *Hincks*, Ann. N. H. ser. 2, viii. (1851) 355: *Busk*, B.M. Cat. ii. 56, pl. lxxi.: *Smitt* (1, forma *pilosa*), *Oefvers. K. Vet.-Ak. Förh.* 1867, 368 and 415, pl. xx. fig. 49 (var.).

MEMBRANIPORA STELLATA, *Thomps.* Ann. N. H. ser. 1, v. 101.

ANNULIPORA PILOSA, *Gray*, B.M. Rad. 107.

ANNULIPORA DENTATA, *Gray*, *ibid.*

REPTLECTRINA PILOSA, *D'Orbigny*, Pal. Franç. Terr. Crét. v. 334.

REPTLECTRINA DENTATA, *id.* *l. c.*

Zoæcia ovate, more or less prolonged, and narrowed below*, the walls thickly covered with minute oval disks, and often with a silvery sheen; area oval or suborbicular, sometimes much elongated, surrounded by a smooth thickened border; marginal spines 4-12; below the area a single corneous spine, often of great length, sometimes aborted. *Oæcia* none.

Var. *a* (*dentata*). With numerous, slender, acuminate spines which bend inwards over the area; the horny spine wanting; *zoarium* assuming a stellate mode of growth, the cells running out in lines two, three, or four abreast.

Var. *β* (*laxa*, *Smitt*). *Zoarium* consisting in great part

* "*Subturbinata*," *Pallas*.

of lines of cells arranged in single series, which sometimes anastomose so as to form a rude network.

Var. *γ*. *Zoarium* rising into frond-like expansions, and frequently much branched [Pallas].

Polypides with 11–14 rather thick tentacles, each of which is furnished with a number of very delicate setiform appendages (tactile hairs), ranged along the back.

RANGE OF VARIATION. The appearance of this species is much affected by the presence of a greater or smaller number of spines, and the degree in which the corneous vibraculoid appendage is developed. One variety, which usually spreads over stone and shell, forms a delicate silvery crust; while another, investing the fronds of Algæ, has the appearance of a coarse brown coating, which bristles with the tall setæ. In the former the aperture is almost completely surrounded by slender, acuminate, incurved spines, of which one, placed in the centre of the lower margin, exceeds the rest in size. In other cases the marginal spines are much fewer in number, and often short, subconical, and erect. In one variety (Plate XXIII. fig. 3) they seldom exceed three, of which two are situated at the upper part of the cell, and one below the aperture. The horny appendage rises from a kind of socket, and frequently attains an enormous size. In many cases it is aborted; in others it is present in abnormal profusion. Sometimes there are two, sometimes three together; and I have seen a cell round which no less than six were developed, the small marginal spines being also present. Occasionally one or two of the tall horny spines are intercalated amongst the latter.

There are also differences in the size of the aperture and the proportion which it bears to the inferior portion of the cell. In one marked variety it is much elongated,

and occupies almost the whole of the front of the cell; more commonly it is placed at the upper part of it, occupying about half its length or less. In the former case an approach is made to the form which we have in *M. membranacea*, in which the prolongation of the cell below the aperture is almost entirely wanting.

Besides these variations in the structural details there are others in the habit of growth (Vars. β and γ).

HABITAT. On stones and shells (var. *dentata*) from the Coralline ground and from deep water, and on *Laminariæ* and other Algæ (masses of which are often completely coated by it), Sertularians, &c., between tide-marks and in shallow water.

LOCALITY. Universally distributed on our coasts, and extremely abundant.

GEOGRAPHICAL DISTRIBUTION. Roscoff, everywhere abundant on *Fucus serratus*, and especially on *Rhodomenia palmata* (Joliet): Belgium (Van. Ben.): Mediterranean (Risso): Adriatic, common (Heller): Aden; Arabian Sea, on weed taken up between Bombay and Aden, lat. about 15° N., long. about 65° E. (W. Oates): Melbourne; New Zealand (T. H.): Norway, var. *laxa* (Sars): Høugesund; Heligoland, about 100 fms. (Kirchenpauer): Finmarck (Goës and Malmgren): Greenland (Lütken): Gulf of St. Lawrence; Nova Scotia (Dr. Dawson): South Labrador, common on *Desmarestia*, just below low-water mark (Packard): var. *stellata*, New Jersey and Rhode Island, on *Lam. saccharina*, &c., common (Leidy): Baltic, Eastern basin, abundant (K. Möbius).

In its more delicate forms, as developed in the hollow of a shell, or spreading, as I have seen it, over the surface of one of the red Algæ, this is a beautiful species. Its little cells have a metallic lustre, and almost look as if

they were wrought in silver and richly chased. In its ordinary condition it has a coarse spongy appearance. It is probably the commonest and most abundant of the British Polyzoa.

The polypides are furnished with the curious intertentacular organ, which I have described elsewhere*. The tentacles are liable to many irregularities, and are often of very different sizes on the same polypide. Very commonly those on one side are inferior in height to those on the other, and the tentacular bell is obliquely truncate above. The same peculiarity has been noticed by Dr. Farre in *Alcyonidium gelatinosum*.

The palpoils on the back of the tentacles are of considerable length.

MEMBRANIPORA MEMBRANACEA, Linnæus.

Plate XVIII. figs. 5, 6.

FLUSTRA MEMBRANACEA, *Linn.* Syst. ed. 12, 1301: *Müller*, Zool. Dan. Prod. 253: *Ellis & Sol.* Zooph. 18: *Fleming*, B. An. 536: *Lamx.* Pol. corall. flex. 107: *Couch*, Corn. Faun. iii. 123, pl. xxi. fig. 2: *Johnston*, B. Z. ed. 2, 348, pl. lxvi. figs. 1, 2, 3.

FLUSTRA TELACEA, *Lamk.* An. s. Vert. ed. 2, ii. 223.

MEMBRANIPORA MEMBRANACEA, *Busk*, B.M. Cat. ii. 56, pl. lxxviii. fig. 2: *Blainv.* Actinol. 447 (not the *M. pilosa*, forma membranacea of Smitt).

REPTÓFLUSTRA TELACEA, *D'Orbigny*, Pal. Franç. Terr. Crét. v. 328.

Zoæcia oblong, disposed in lines, alternate, with a stout hollow spine at each angle above; area occupying the whole of the front of the cell, with a membranous covering; margin smooth. *Avicularia* none. Closed tubular processes frequently developed from the front wall of the cell.

Polypide with about 20 very long tentacles.

* *Vide* the Introduction to the present work.

Colonies forming a delicate network, often extending to a length of several feet on the fronds of the larger *Fuci*.

RANGE OF VARIATION. Distinguished for great regularity of growth and constancy of character.

HABITAT. The fronds of *Laminaria digitata* and other *Fuci*.

LOCALITIES. Universally distributed on our coasts, and very abundant.

GEOGRAPHICAL DISTRIBUTION. Hvidingsoe; Hougessund (Kirchenpauer): Roscoff, on *Saccorhiza bulbosa* (Joliet): Adriatic, on sea-weeds (Heller): Lyall's Bay, New Zealand, on *Fucus* (F. W. Hutton): Australia (MacGillivray).

RANGE IN TIME. Coralline Crag; Palæolithic (A. Bell).

This species is one of the commonest of our British Polyzoa, as it is undoubtedly one of the most beautiful. Wherever *Laminaria digitata* is present its exquisite lace-work is almost sure to be found, lighting up the sombre fronds, and itself appearing all the more delicate in contrast with the dark surface over which it spreads.

It possesses a power of free and rapid development corresponding with the size of the marine plants in which it principally delights; and the huge fronds of the *Laminaria* are often swathed in its silvery net. Dr Landsborough mentions a specimen 5 feet in length by 8 inches in breadth; and probably most tangle-beds of any size would yield a similar growth.

I have noticed in some cases a remarkable thickening of the membranous front wall of the cells in this species. This is sometimes carried to such an extent that the whole of the free surface of the zoarium seems to be covered by it, except the extremities of the spines.

The curious tubular processes*, which have been supposed to be ovicells, are often developed in enormous numbers. They are irregularly distributed over the zoarium, and frequently occur in groups. Mr. Couch speaks of them as appearing in December, January, and February; but I have met with them in June and October, and it seems probable that they are not confined to any particular season.

The polypides have about 20 tall tentacles, which form a very graceful bell. They are sometimes furnished with the ciliated intertentacular organ which occurs on *M. pilosa* and other species. A colony in full health and vigour affords a rare display of delicate structure, vivacious movement, and graceful form.

* Ellis was the first to notice these bodies. "There are dispersed," he says, "here and there, at regular distances over the surface, little transparent, short, erect tubes; but to what use I shall not pretend to determine, unless they are the ovaries."—*Ellis & Solander, Zooph.* p. 18. Couch describes them as "of a yellow colour, semitransparent, and filled with minute yellow granules, which appear to be ova" (*Corn. Faun.* pt. iii. p. 93).

These processes are cylindrical, and consist of a perfectly transparent chitinous tube, which is lined throughout by a brownish membranous sac. The sac is frequently inverted towards the top of the tube. They are closed above, and open into the cavity of the cell at the base (Plate XVIII. fig. 6). They appear at first as a swelling on the front wall of the cell, sometimes placed at one end of it, sometimes subcentrally. The zoœcia on which they are developed are frequently abnormal in shape, being roundish and much larger than is usual. The processes attain a very considerable length. So far as I have observed, there is no trace of a polypide in the cells to which they are attached; I have never seen any thing within them except a small quantity of granular matter, and have been unable to obtain any clue to their history.

These bodies have been investigated by Nitsche, who describes the zoœcia on which they occur under the name of "tower-cells" ('Thurmzoöcien'). He is inclined to regard the latter as zoœcia, originally normal, which, having lost their polypides, instead of developing others, have undergone this curious transformation ("Ueb. d. Anatom. u. Entwickl. von *Flustra membranacea*," *Zeitsch. f. Wissensch. Zool.* xxi. Bd. 4. Heft, pp. 64, 65). According to this view they are merely abnormal growths.

MEMBRANIPORA HEXAGONA, Busk.

Plate XVIII. fig. 7.

MEMBRANIPORA HEXAGONA, *Busk*, Quart. Journ. Micr. Sc., Zoophytology, iv. 308, pl. xii. fig. 4.FLUSTRA CORIACEA, *Johnst. B. Z.* ed. 2, 348 (the diagnosis by Forbes), pl. lvi. fig. 8.*Zoæcia* hexagonal or subelliptical; surface smooth; margin smooth and even; mouth semilunar.

HABITAT. On shells and stones.

LOCALITIES. Isle of Man, on *Pecten opercularis* (E. Forbes): coast of Devon (Miss Cutler).Mr. Busk is probably correct in identifying E. Forbes's *Flustra coriacea* with the present species.I know nothing of *M. hexagona* but what may be gathered from the brief description and figure in the 'Zoophytology.'

Judging from the figure, the covering of the area is wholly membranous, and the zoarium appears to form a thin flat crust.

MEMBRANIPORA LINEATA, Linnæus.

Plate XIX. figs. 3-6.

FLUSTRA LINEATA, *Linn. Syst.* ed. 12, 1301: *Fabr. Faun. Grænl.* 437: *Johnst. B. Z.* ed. 2, 349, ? pl. lxvi. fig. 4*.

* There is much difficulty in determining the synonymy of this and the allied spiniferous forms, as the descriptions of authors are often extremely vague, and have probably in many cases been based on specimens of more than one species.

Johnston's figure of his *F. lineata* is useless as a means of identification.

?TATA RUGOSA (part.), *Van Ben.* Bull. Ac. Roy. Belg. xvi. no. 12, 648, pl. ii. fig. 12.

CALLOPORA LINEATA, *Gray*, B.M. Rad. 109.

REPTOELECTRINA LINEATA, *D'Orb.* Pal. Franç. Terr. Crét. 334.

MEMBRANIPORA LINEATA, *Busk*, B.M. Cat. ii. 58, pl. lxi. fig. 1: *Alder*, North. Cat., Trans. Tynes. Field Club, iii. 143, pl. viii. fig. 1: *Smitt*, forma 2, *Cefvers.* K. Vet.-Ak. Förh. 1867, 364 and 390, pl. xx. fig. 23; *Florid. Bryoz.* pt. ii. 7, pl. ii. fig. 62: *Manzoni*, *Bryoz. foss. Ital. Contrib.* iv. 10, pl. ii. fig. 13 [not pl. iii. fig. 14].

Zoæcia oval, slightly expanded below, separate; the margin with 6–12 spines, of which two are placed at the top of the cell and directed somewhat upwards, the second pair stand erect; and the rest, which are slender, and not flattened, bend inwards; a rather large, raised avicularium at the bottom of the cell, with triangular mandible directed downwards. *Oæcia* large, globose, shining, with an arched rib towards the top, an avicularium usually on one side of it above, with the mandible pointing upwards.

Colonies forming subcircular patches.

RANGE OF VARIATION. The spines vary in number, but are always less numerous than in the two following species, twelve being about the maximum, and eight or ten the more usual number. They are sometimes almost erect, but more commonly they bend *slightly* inwards.

A variety occurs (*a*) in which the margin is armed with six spines only, two at the top and two on each side. The cells are larger than usual, and the border rather broad and crenate. The avicularia are very large and much elevated.

The cells also vary somewhat in shape and size. Normally they are pretty regularly oval, widening a little below; but occasionally they are much shortened and almost orbicular in form. Sometimes they lie rather widely apart.

HABITAT. On weed, stone, shell, &c., from between tide-marks to deep water. It is more especially a littoral form, and is developed in extraordinary luxuriance on some of the *Fuci*.

LOCALITIES. Common, and widely distributed. Shetland, on *Fuci* and *Laminariæ*; Hebrides (A. M. N.): Wick (C. W. P.): Northumberland and Durham, from tide-marks to deep water, frequent on *Patella lævis* (Alder): Isle of Man; Ilfracombe, on *Laminariæ*; South Devon, between tide-marks; Mount's Bay, under stones (T. H.): Hastings, normal and var. *a* (Miss Jelly): &c.

GEOGRAPHICAL DISTRIBUTION. Roscoff, on *Laminaria saccharina*, common (Joliet): coasts of Skandinavia, in shallow water, common (Smitt): Baltic (Lenz): Spitzbergen (Lovén): Davis Strait, 100 fms.; Reykjavik Harbour, Iceland, 15–20 fms. (Wallich): Nova Zembla, 3–50 fms.; Kara Sea (Nordenskiöld, *fide* Smitt): South Labrador (Packard): Adriatic (Heller): Florida, on coral, 42 fms. (Pourtales): New Zealand (F. W. Hutton).

RANGE IN TIME. Italian Pliocene and Miocene deposits (Manzoni).

M. lineata is readily distinguishable from the allied British species, and on the whole is very constant in character. Smitt unites it with *M. craticula*, *M. unicornis*, and several others under one specific designation. But there are no intermediate varieties, so far as I know, connecting together the present species and *M. craticula*: they are well-defined forms, each with a marked *facies*, separated from one another by a group of constant characters, and exhibiting, according to my experience, a very moderate amount of variability. It may be remarked, too, that amongst Smitt's figures referred to his *M. lineata* there is certainly nothing that makes any approach to *M. craticula*.

It is of course easy to understand how they may have been derived from a common and not very remote ancestor through a process of gradual modification ; but in their actual condition they seem to be sufficiently distinct and stable forms*.

M. lineata differs from *M. craticula* in the larger size and much less regular arrangement of its cells, and in the character of the spines, which are rounded, and not flattened, fewer in number, and much less recumbent than in the other form. The disposition of the spines in *M. craticula* is very distinctive, and gives a decided individuality to the species. There are also differences in the ovicells. The avicularium of the present species is large and much raised, and projects very prominently at the base of the cell.

Towards the margin of the colony the cells are sometimes slightly produced below the aperture, so as to assume to a certain degree the form which we have in the normal *M. monostachys*. Round the lower part of the zoœcia there are several rather large oval orifices (intercellular communications), one placed at the top and bottom, and two on each side. On the inner edge of these foramina there are generally a few minute denticles.

* The truth seems to be that the difference between Prof. Smitt and myself lies chiefly in the conception we have respectively adopted of a *species*. By a "form" he intends to denote what I should name in a large proportion of cases a *species*. His "species" is a block of "forms," the various elements of which are supposed to be so related and interconnected as to constitute an evolutionary series which is properly regarded as a whole. But to sustain this view an amount of variability is assumed of which I can find no sufficient proof ; I have certainly had no experience of the "innumerable transition-forms" ("*otalika mellanformer*"), which, according to Prof. Smitt, bind together *M. craticula* and *M. lineata*. That they are not distantly related I have no disposition to deny ; but whatever their history may have been in the past (and the same may probably be said of the other five species which Prof. Smitt refers to his *lineata*-stock), they are now distinct and well-established forms, and should be treated as such in our systems. We must have much more evidence of variability than we yet possess to justify us in merging them in one specific group.

MEMBRANIPORA CRATICULA, Alder.

Plate XIX. fig. 7.

FLUSTRA LINEATA, *Couch*, Corn. Faun. pt. iii. 124, pl. xxii. fig. 15?MEMBRANIPORA CRATICULA, *Alder*, North. Cat., Trans. Tyneside Field Club, iii. 144, pl. viii. fig. 3.MEMBRANIPORA LINEATA, 1, forma CRATICULA, *Smitt*, Öfvers. K. Vet.-Ak. Förh. 1867, 363.

Zoæcia small, in very regular, radiating, linear series, oval, somewhat narrowed above; the margin with about thirteen spines, of which the two uppermost pairs are erect and often of very great length; the rest flattish, glistening, closely set, bent inwards, and meeting across the cell, especially crowded together at the bottom of it: an *avicularium*, with acute mandible directed downwards, at the base of the cells. *Oæcia* rather small, smooth, cylindrico-globose, with a rib across the middle; an *avicularium* at the top or at one side, with the mandible pointing upwards.

Primary cell subcircular; aperture terminal, with about nine marginal spines.

Colonies forming small flabellate or subcircular patches, with a soft spongy look, from the great number of closely-set spines.

RANGE OF VARIATION. I have observed very little variation in this species. There are slight differences in the number of the spines; but the chief features are very constant and uniform.

HABITAT. On shells, &c., from shallow to deep water, and on littoral sea-weeds.

LOCALITIES. Northumberland and Durham, on *Modiolæ* from deep water (Alder): Isle of Man, very abundant on shells dredged off Maughold Head; Oban (T. H.): St. Andrews, occasionally in deep water (Dr. McIntosh):

Shetland, shallow water, Hillswick ; on *Laminariæ*, Bressay Sound (A. M. N.): Wick and Peterhead ; Cornwall (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Davis Strait, 100 fms. (Wallich) : Gulf of St. Lawrence (Dawson) : Bahusia, 7-10 fms. (Smitt) : Spitzbergen, on *Cellulariæ*, hydroids, &c., 20-45 fms. (Swedish Exped.) : Nova Zembla, 4-60 fms. ; Kara Sea (Nordenskiöld).

RANGE IN TIME. Scotch Glacial deposits (Geikie).

This is an exceedingly pretty species, recognizable at a glance by its general aspect, even without a minute examination of the characters. The cage-like appearance of the little cells, with their closely-set glittering bars, their small size, and the extreme regularity of the linear series in which they are disposed, are points which at once arrest attention.

The spines are crowded together at the lower part of the cell, over which they bend, and converge to a central point. The two immediately below those which stand erect are larger than their companions ; and their free extremities curve upwards. It should be noted that there is an essential difference between the erect spines and those which bend inwards and protect the area of the cell. The latter only exhibit the flattish glistening appearance so characteristic of the species ; the others are rounded and of the usual type.

M. craticula, so far as our present knowledge goes, must be accounted a rare species.

MEMBRANIPORA SPINIFERA, Johnston.

Plate XIX. figs. 1, *a*, *b*, *c*.FLUSTRA SPINIFERA, *Johnst.* Newc. N.H.S. Trans. ii. 266, pl. ix. fig. 6.? FLUSTRA LINEATA (part.), *Johnst.* B. Z. ed. 2, 349.MEMBRANIPORA SPINIFERA, *Alder*, North. Cat., Trans. Tynes. Field Club, iii. 143, pl. viii. fig. 2: *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 29 [not *M. spinifera* of Smitt, *Œfvers. K. Vet.-Ak. Förh.* 1867, 366 & 411, pl. xx. fig. 32*].

Zoæcia elongate-oval, contiguous, arranged in lines; the margin with about 14–16 tall and stout spines, two of them at the very top of the cell, the second pair erect and very large, the rest bending inwards. *Avicularia* pedicellate, borne on a short and slender stem, which tapers downwards, developed on the cells, outside the row of spines; mandible acute and directed upwards.

Oæcia shallow, smooth, with a rib across the front.

Colonies forming rather large, circular, brownish patches.

RANGE OF VARIATION. I have only noticed slight differences in the size of the cells and the number of the spines. The avicularia are sometimes very sparingly produced, or at least are present in very small numbers. It is very probable that their absence in such cases may often be due to accidental causes; for the pedicle by which they are connected with the cell is much attenuated below, and they must be easily detached from their place. On some specimens almost every cell is furnished with one of these curious appendages.

HABITAT. Chiefly on stones, between tide-marks; also on *Laminaria* and on shells, &c., from moderate depths.

LOCALITIES. Northumberland and Durham, “on the

* This is the *M. cymbæformis*, mihi, an Arctic and North-American form. *Vide* a paper by the author in the *Annals & Mag. N. H.* for Jan. 1877, p. 110.

underside of stones, between tide-marks, frequent; more rarely in shallow water" (Alder): Shetland, on stones, between tide-marks (A. M. N.): Birterbuy Bay (G. S. B.): Isle of Man, between tide-marks; Salcombe, Devon; Cornwall (T. H.): St. Andrews, abundant between tide-marks (Dr. M'Intosh).

GEOGRAPHICAL DISTRIBUTION. France, south-west (Fischer).

From *M. lineata* the present species is readily distinguished by its elongate closely-set cells, its numerous stout spines, and its remarkable avicularium. In the latter we have a very interesting transition-form, standing between the highly specialized movable appendage which we meet with in the genus *Bugula*, and the ordinary avicularium of the *Membraniporidæ*. A short and very slender pedicle supports the avicularian cell, which widens gradually upwards above it, so that the whole structure presents a somewhat clavate figure. Above, it is obliquely truncate, and terminates in a pointed beak-like apex. On this truncate portion the acute mandible is placed, directed upwards towards the beak. The whole appendage bears a very close general resemblance to a cell of the common *Eucratea chelata*.

The pedicle near its point of junction with the base of the cell is extremely slender, and composed of very delicate material; and it is quite possible that the appendage may possess a certain amount of mobility, even though not endowed with any special motor apparatus. On this point, however, I cannot speak with certainty, as I have never had the opportunity of examining the species in a living state. Alder describes the avicularia as "developed sparingly on any part of the margin of the cell;" but, according to my observations, they are very constant in

position, and occur on the side of the cell (not on the *margin*) in the neighbourhood of the first pair of spines below the orifice. It is perhaps hardly necessary to add that they bear no morphological relation whatever to the spines.

MEMBRANIPORA FLUSTROIDES, Hincks.

Plate XIX. fig. 2.

MEMBRANIPORA FLUSTROIDES, *Hincks*, Ann. N. H. Sept. 1877, ser. 4, xx. 213, 214.

Zoæcia large, in regular lines, set closely together, oval; margin with 12-14 massive, flattish, sometimes subclavate, sometimes bifid spines, which bend inwards, and almost meet across the area, with the exception of the two uppermost, which stand erect; an oval *avicularium* on a somewhat quadrate area at the top of many of the cells, slanting upwards, with a semicircular mandible. *Oæcia* very small and inconspicuous, smooth, elevated in front, forming a hood-like covering over the extreme end of the cell.

Colonies forming large subcircular patches with a somewhat lobate edge.

RANGE OF VARIATION. Very limited. The cells are occasionally smaller than usual; and there are very slight differences in the number of spines. At times two *avicularia* occur side by side; and rarely one is met with abnormally large. When developed above an ovicell, the *avicularium* is commonly placed transversely. With the exception of such slight differences, there is a remarkable constancy of character in this well marked and very interesting form.

HABITAT. Stones, shells, &c., from moderate depths and from deep water.

LOCALITIES. Antrim (Hyndman) : off Donaghadee, 32 fathoms (Mr. W. Swanston) ; Guernsey ; off the Deadman, Cornwall, 60 fathoms ; South Devon (T. H.) : Birterbuy Bay (A. M. N.).

The massive, often subclavate, spines and the avicularium, which is of the Flustrine type, distinguish this fine species from the other *Membraniporæ*. The avicularium is always placed, as amongst the *Flustra*, immediately above the zoecium, in a distinct area, which is in a line with the cells. We have a similar form in *M. cornigera*. Through the present species and such a form as *Flustra denticulata*, Busk, a very close relationship is established between the families of the *Flustridæ* and *Membraniporidæ*.

MEMBRANIPORA DISCRETA, Hincks.

Plate XIX. figs. 8, 9.

MEMBRANIPORA DISCRETA, *Hincks*, Devon & Cornw. Cat., Ann. N. H. ser. 3, ix. 200, pl. xii, fig. 1 (page 40, sep.).

Zoecia ovate, separate, varying in size, and irregularly disposed ; the margin cut into about twenty lobes, supporting as many delicate, sharply pointed spines, which bend slightly inwards. *Oæcia* very small, globose, frosted.

In the only two specimens I have seen, the colonies consist of very minute and inconspicuous groups of cells.

HABITAT. Shells from moderately deep water.

LOCALITIES. South Devon ; Guernsey (T. H.).

I do not identify the present species with Smitt's *M. lineata*, forma *discreta*, which, so far as I can judge from

his description and figure, seems to be a distinct form. He represents a large, much elongated avicularium in the spaces between the cells; but *M. discreta* is destitute of avicularia. In other respects the two appear to differ.

In the present species the cells are very irregularly grouped, and vary considerably in size, and the colony has a somewhat confused and disjointed appearance. The entire margin is divided into distinct lobes, ranged closely together, which may be traced down the exterior wall of the cell; and each of them bears a spine. They number about twenty or upwards. The spines, with the exception of one or two near the top, are very delicate and bend inwards. The oecium is small and rounded, and minutely granular.

From *M. lineata* this species is distinguished by the characters just enumerated, to which the former, I believe, makes no approach in any stage of its development.

MEMBRANIPORA CURVIROSTRIS, Hincks.

Plate XX. figs. 5, 6.

MEMBRANIPORA CURVIROSTRIS, *Hincks*, Devon & Cornw. Cat., Ann. N. H. ser. 3, ix. 29, pl. vii. fig. 4 (p. 39, sep.).

Zoecia elongate-oval, margin granular and somewhat thickened, the inner edge minutely serrulate; a short stout spine on each side near the top, which projects in front of the ovicell, and at the bottom a single subconical spine; no calcareous lamina; large suberect *avicularia* distributed amongst the cells on distinct areas, with curved and pointed mandible, directed upwards. *Oecia* prominent, subglobose, rather shallow, strongly frosted.

Colonies forming a delicate pearly-white lacework.

RANGE OF VARIATION. There are slight differences in the shape of the cell (the prevailing form being a very regular oval) ; and the spine at the bottom is sometimes wanting.

HABITAT. Stones from deep water.

LOCALITY. Ten or twelve miles south of Polperro, in 40 fathoms (T. H.).

The avicularium is the striking feature of this species. It is of very large size, suberect, and furnished with a triangular mandible, which is much curved towards the tip. A very interesting peculiarity is the distinctness of the area on which it is placed. It resembles very closely that of the ordinary cells, being only slightly smaller and having a similar granulated margin. The avicularium rises out of the lower part of this inclosed cell-like area, which it fills, the space above it being unoccupied and destitute of membranous covering. The relation between the appendage and the ordinary zoecium is very clearly indicated in this species.

I have a closely allied form from Singapore, which is principally distinguished by the character of the avicularium.

MEMBRANIPORA UNICORNIS, Fleming.

Plate XX. fig. 4.

FLUSTRA UNICORNIS, *Flem. Br. An.* 536.

MEMBRANIPORA MEMBRANACEA, *Johnst. B. Z.* ed. 2, 328 (part.) ?

?LEPRALIA SQUAMA, *Dalzell, Rem. An. Scotl.* ii. 79, pl. xxv. figs. 14, 15 *.

MEMBRANIPORA UNICORNIS, *Alder, North. Cat., Trans. Tynes. F. C.* iii. 146, pl. viii. fig. 6.

MEMBRANIPORA LINEATA, 5, forma UNICORNIS, $\beta\beta$, stadium longius adultum, *Smitt, Cefvers. K. Vet.-Ak. Förh.* 1867, 365 and 399, pl. xx. fig. 30.

* This and the preceding are very doubtful identifications.

Zoæcia large, oval, quincuncial, the margin granulated ; two spines on each side, near the top of the cell, the lower pair showing in front of the ovicell. *Oæcia* sub-cylindrical, smooth, with a strong rib just above the margin, and bearing on their summit a large conical avicularium. In the absence of the ovicell the avicularium occupies the space at the bottom of the cell, placed somewhat obliquely, and with the mandible directed downwards.

Colonies forming a rather coarse network, spreading in subcircular patches.

RANGE OF VARIATION. There are occasionally two avicularia at the base of the cell, which are placed one towards each side. The zoæcia are very uniform in size and shape.

HABITAT. On shells, stones, Ascidians, &c., from shallow to deep water ; occasionally between tide-marks.

LOCALITIES. Northumberland and Durham, old shells, &c., frequent (Alder) : Balta Sound, between tide-marks (C. W. P.) : St. Andrews, deep water (Dr. M'Intosh) : Dogger Bank (T. H.).

GEOGRAPHICAL DISTRIBUTION. Bohuslän, at great depths ; north of Spitzbergen, 6-50 fathoms (Smitt) : Greenland ('Valorous' dredgings) : Nova Zembla, 10-60 fms. (Nordenskiöld).

RANGE IN TIME. Scotch Glacial deposits (Geikie).

The avicularium in this species is large and massive, and very decidedly suberect. The zoæcia are of much stouter build than in the following. The points of difference between the two species are given in detail under *M. Dumerilii*.

MEMBRANIPORA DUMERILII, Audouin.

Plate XX. fig. 3.

- FLUSTRA DUMERILII, *Aud.* Expl. Savigny Égypte, Polypes, pl. x. fig. 12.
 MEMBRANIPORA MEMBRANACEA (part.), *Johnst.* B. Z. ed. 2, 328, pl. lvi. fig. 7.
 MEMBRANIPORA FLEMINGII, *Busk*, B.M. Cat. pl. civ. fig. 2.
 MEMBRANIPORA POUILLETII, *Alder*, North. Cat., Trans. Tynes. F. C. iii. 146, pl. viii. fig. 5; Quart. Journ. Micr. Sc. v. 248: *Busk*, Crag Pol. 32, pl. iii. figs. 4 & 6.
 MEMBRANIPORA DUMERILII, *Norman*, Rep. Brit. Assoc. for 1866, 305: *M'Intosh*, Mar. Invert. of St. Andrews, 45.
 MEMBRANIPORA LINEATA, 5, forma UNICORNIS, *α α*, stadium juvenile, *Smitt*, (Efvers. K. Vet.-Ak. Förh. 1867, 365 & 397, pl. xx. fig. 29.

Zoecia small, ovate, broad below, very regularly quincuncial; margin granulated, with a thin edge; spines four (rarely six), placed two on each side, near the top of the cell, the lower pair showing below the ovicell, one of them sometimes enormously developed. *Oæcia* large, globose, or elongated, strongly frosted; a small pointed *avicularium* on each side above, or on one side only; mandible directed upwards and slightly outwards. In the absence of the ovicell, an avicularium usually at the base of the cell, placed transversely, with the mandible directed downwards.

Colonies forming a neat, pearly lacework.

RANGE OF VARIATION. There are slight diversities in the shape of the cell; but in its prevalent and characteristic state it is contracted at the top and broad below. The ovicell is often much produced; but it also assumes a more rounded form.

HABITAT. Chiefly on shells, stones, &c., from shallow to deep water; occasionally on *Laminaria*.

LOCALITIES. Shetland, occasionally on *Cellepora cervicornis* and shells; Hebrides (A. M. N.): St. Andrews, on bivalves from deep water (Dr. M'Intosh): Northumberland and Durham, on shells and zoophytes, especially on

Flustra foliacea (Alder) : Arran ; Dogger Bank ; Isle of Man ; South Devon, abundant on shells, &c. ; Ilfracombe, on *Laminaria* ; Cornwall, off the Deadman, in 60 fathoms, on stone (T. H.) : Hastings (Miss Jelly) : Antrim (Hyndman) : &c.

GEOGRAPHICAL DISTRIBUTION. Scandinavian Seas (Smitt) : ? Mediterranean (Savigny) : France, south-west (Fischer).

RANGE IN TIME. Coralline Crag, on shell (S. Wood).

This species is distinguished from the last by several well-marked characters, though the two forms are nearly related. The cells are much smaller than those of *M. unicornis*, and not so regularly oval. There is, indeed, some amount of variation in form ; but the cell in *M. Dumerilii* is usually narrowed towards the top and expands below ; while that of the kindred species is of a pretty uniform elongate-oval shape. The chief difference lies in the ovicell, which is globose, or (very often) considerably elongated, and strongly granulated ; that of *M. unicornis*, on the other hand, is smooth, with a rib across the front of it, just above the margin, and a prominent avicularium on the summit, "giving the whole," as Alder has remarked, "the appearance of a Phrygian bonnet." The general aspect of the two species is very different. The lacework of *M. unicornis* is much coarser than that of its ally, and wants its remarkably delicate and pearly texture.

The enormous development of one of the spines in front of the ovicell, which is so common in the present species, I have never noticed in *M. unicornis*.

Smitt remarks that the form which he refers to *M. Dumerilii* differs from that which Alder figures (*l. c.* pl. viii. fig. 5) in having the mandible of the avicularium directed towards the centre of the colony. His figure, how-

ever, is taken from a specimen *without ovicells*; and in such cases the avicularium is almost universally so placed. Alder's, on the contrary, represents a fertile group; and whenever the ovicell is present, the direction of the avicularium is always reversed and it points upwards. This remark applies equally to other species.

MEMBRANIPORA SOLIDULA, Alder and Hincks.

Plate XX. figs. 7, 8.

MEMBRANIPORA SOLIDULA, *Hincks*, Proc. Dublin Univ. Zool. & Botan. Assoc. ii. pt. 1 (1860), 75.

Zoæcia oval, with a crenulate margin, the membranous covering opaque and of a dull waxy appearance, lying very much on a level with the margin, so that the zoarium presents a very flat surface; four spines at the upper end of the cell immediately above the semicircular orifice; frequently one or two prominent smooth nodules below the base of the cell. *Oæcia* globose, subimmersed, shallow, smooth, with a strong thickened ridge across the upper part. *Avicularia* none.

RANGE OF VARIATION. Slight differences in the shape of the cells, which are occasionally somewhat narrowed towards the top and expand below.

HABITAT. On shells, stones, &c., from moderate depths to deep water.

LOCALITIES. Off the coast of Antrim (Hyndman): Guernsey (T. H.): Hastings (Miss Jelly).

Some of the peculiarities of this species were pointed out to me by the late Mr. Alder; and I have therefore associated his name with it as well as my own.

The cells are small and regular in form, with a prettily

beaded margin. The flatness and dull opaque look of the surface of the zoarium are very characteristic. The nodules are sometimes a conspicuous feature.

MEMBRANIPORA AURITA, Hincks.

Plate XXI. figs. 5, 6.

MEMBRANIPORA AURITA, *Hincks*, Ann. N. H. ser. 4, xx. 213 (Sept. 1877).

Zoecia ovate, somewhat expanded below, disposed with great regularity in quincunx; area with a membranous covering; no calcareous lamina; margin plain, in young cells armed with four spines, of which one is usually present in the adult, placed about halfway down the side; immediately above each cell, or the ovicell when present, two raised avicularia, one on each side, with a pointed mandible usually directed upwards and slightly outwards. *Oecia* subglobose, partially immersed, with a strong rib on the front, rising to a point above and inclosing a triangular space.

Colonies forming large subcircular patches, resembling the most regular lacework.

HABITAT. On stones and shells.

LOCALITIES. Cornwall and Devon (T. H.): Antrim (Hyndman): Northumberland (Alder).

From *M. Flemingii* this species is distinguished by the more regularly ovate form of its cell, the entire absence of a calcareous lamina, the triangular figure on the front of the ovicell, and the perfectly regular quincuncial arrangement of the cells. The latter character is a very marked one; and in well developed specimens the species may be at once recognized by it.

Of the four spines which occur on young marginal cells

one only is usually permanent, but occasionally a second survives. When the ovicell is absent there is some amount of irregularity in the number and position of the avicularia; sometimes the mandibles are turned downwards, as is frequently the case amongst the *Membraniporæ* under such circumstances; sometimes only a single avicularium is developed, which is placed crossways, or in the centre, with its mandible pointing straight downwards. This very distinct form has probably been confounded with *M. Flemingii*, which, as I have pointed out elsewhere, has had a character for inconstancy which it by no means deserves.

MEMBRANIPORA IMBELLIS, Hincks.

Plate XX. figs. 1, 2.

MEMBRANIPORA IMBELLIS, *Hincks*, Quart. Journ. Micr. Sc. viii. (1860), 275, pl. xxx. fig. 1; Devon & Cornw. Cat., Ann. N. H. ser. 3, ix. 28 (38 sep.): *Norman*, Shetland Polyzoa, Rep. Brit. Ass. 1868, 305.

Zoæcia large, pyriform, contracted above and much expanded below; covering of the area wholly membranous; margin crenate or coarsely granulated, thickened, especially at the bottom of the cell, where it is usually somewhat produced and pointed. *Oæcia* very prominent, frosted, with a depressed somewhat quadrate area in front. No spines or avicularia.

RANGE OF VARIATION. There is very great constancy in the leading characters. The cells differ to some extent in shape and size, and occasionally assume a subtriangular form.

HABITAT. On shells, stones, &c., from deep water.

LOCALITIES. Coast of Antrim (Hyndman): Scotland,

west coast; Brixham, from the trawl-boats; off the Deadman, 60 fathoms (T. H.): The Minch; Shetland, rare, 40-50 fathoms, 5-7 miles east of Balta (A. M. N.).

This species, which seems to be essentially a deep-water form, is distinguished from *M. Flemingii* by the much larger size of its cells, and the total absence of a calcareous lamina and of all spines and avicularian appendages. Mr. Busk regards it as "an unarmed variety" of the last named; but it is not the mere absence of the characteristic armature of *M. Flemingii* that differentiates the present form. The calcareous lamina, covering in the lower portion of the area, which is so important a character of the normal *M. Flemingii*, is universally wanting in *M. imbellis*. In the latter the area is wholly roofed in by a membranous covering as in *M. lineata* and *M. Lacroixii*. At the same time it should be remarked that the spines and avicularia (which constitute its armature) are most characteristic features of *M. Flemingii*. The former may be wanting at times in old and worn specimens; but there is generally a hole or stump to show where they have been. The avicularia, I believe, are always developed in greater or less number on the form with calcareous lamina, to which I restrict the name *Flemingii*; but in *M. imbellis* not a trace of such appendages is to be met with in any stage of growth. Mr. Busk, I venture to think, has credited the former species with a larger amount of variability than really belongs to it. Certain it is that, of the figures which he refers to it in his admirable 'Catalogue,' one or two at least of those which diverge most widely from the normal type (*e.g.* plate civ. figs. 2 and 4, and probably 3) are representations of totally distinct species.

Apart from the important differences to which I have

just referred, the scale and general character of the zoëcia are very dissimilar in the two forms.

I am not acquainted with any other species with which the present can be confounded. *M. irregularis*, D'Orb., with which Busk compares it, exhibits a totally different type of cell.

b. *With a calcareous lamina.*

MEMBRANIPORA FLEMINGII, Busk.

Plate XXI. figs. 1-3.

FLUSTRA MEMBRANACEA, Müller, Zool. Dan. iii. 63, pl. cxvii. figs. 1, 2.

MEMBRANIPORA MEMBRANACEA (part.), Johnst. Br. Zooph. ed. 2, 328 (not pl. lvi. fig. 7).

FLUSTRA TUBERCULATA, Johnst. B. Z. ed. 1, 289.

AMPHIBLESTRUM MEMBRANACEUM, Gray, B.M. Rad. 110.

MEMBRANIPORA FLEMINGII, Busk, B.M. Cat. ii. 58, pl. lxxxiv. figs. 3, 4, 5 (not pl. civ. figs. 2, 3, 4): Alder, Hincks, Heller, &c.

MEMBRANIPORA FLEMINGII, forma TRIFOLIUM (part.), Smitt, l. c., Krit. Fört. iii. 367 and 405, pl. xx. figs. 37 & 40.

Zoëcia ovate, more or less produced below; area contracted above, much expanded and elevated below, filled in for about a third of its length by a calcareous granular lamina; aperture trifoliate; margin much raised, crenated; oral spines six (in young cells usually eight)—two, very tall and slender, placed at the top, and two, much stouter, on each side below them, the foremost of those on one side often enormously developed, and forming a long, flattened, scimitar-like appendage, which is articulated to a short tubular process on the margin. *Avicularia* one on each side below the area, raised, with acute mandible directed upwards and outwards when the ovicell is present, but usually downwards when it is absent; sometimes a single central avicularium, placed trans-

versely. *Oœcia* globose, commonly with a raised line or rib forming an arch across the front of it, and inclosing a minutely granulated area.

Primary cell small, circular, with a membranous covering, and eight or nine erect spines round the margin.

RANGE OF VARIATION. I believe, as I have said elsewhere, that this species has been credited with a much larger amount of variability than it really exhibits. Many of the forms referred to it which diverge most widely from the normal type are in fact distinct species. Its most remarkable variations are due to age, and the consequent loss of characteristic structures.

HABITAT. On shells, stones, Algæ (more rarely), &c., from between tide-marks to deep water.

LOCALITIES. Very common and widely distributed.

GEOGRAPHICAL DISTRIBUTION. East Greenland (Kirchenspauer, N. Germ. Pol. Exped.) : Gullmaren (Smitt) : Adriatic, on mussels, Algæ, and corals (Heller) : Roscoff, common on *Eschara foliacea* (Joliet).

RANGE IN TIME. Scotch Glacial deposits (Geikie) : Palæolithic ; clays of Western Scotland, &c. (A. Bell).

In fully developed specimens, in which the cells are crowded together, their real shape is scarcely apparent. The area seems to occupy the whole of the front ; but, in fact, the cell is produced to a greater or less extent below it ; and it is on this produced portion that the avicularia are situated (Plate XXI. fig. 2). The zoœcia are contracted above, swell out in the middle, and then narrow off towards the lower extremity. The area follows the shape of the upper portion of the cell, and is narrow at the top and very broad below. It is also much elevated towards the bottom, so that the margin surrounding this portion of it stands out very prominently. The spines

are usually a very conspicuous feature. Of the four at the top, which are found in young marginal cells, one or two seem to be deciduous and soon disappear. Six usually remain, of which the two uppermost are tall and slight and sharply pointed, and the rest tubular and comparatively stout. One of them is separated from its companions by differences in size and structure, which show themselves at its first appearance. It consists of a short, tubular base, open at the top, to which a long spinous process is articulated, which often attains a truly gigantic size. It also takes on very commonly a peculiar form, being broad and flattened, and bearing no slight resemblance to the blade of a scimitar. This, however, is not universally the case, since, though always of remarkable size, it seems sometimes to retain the cylindrical shape. When fully developed, this sword-like appendage, bending across the cell as if to guard the entrance, has a very peculiar effect.

Two of the spines, or sometimes four, are visible in front of the ovicell.

There can seldom be much difficulty in recognizing this species. The characters of the area are amply sufficient for identification, apart from the less stable and permanent portions of the structure.

When furnished with its full armature, *M. Flemingii* is eminently picturesque and characteristic.

MEMBRANIPORA CORNIGERA, Busk.

Plate XXI. fig. 4, and Plate XXII. fig. 3.

MEMBRANIPORA CORNIGERA, *Busk*, Rep. Brit. Assoc. 1859, Trans. Sect. 45; Quart. Journ. Micr. Sc. viii. (1860), 124, pl. xxv. fig. 2.

MEMBRANIPORA FLEMINGII, 1, forma CORNIGERA, *Smitt*, Öfvers. K. Vet.-Akad. Förh. 1867, 367 and 403, pl. xxiv. fig. 1.

Zoæcia pyriform, or somewhat lozenge-shaped; lamina minutely granular, filling in more than half the area; margin not beaded, armed with six spines, of which two are placed at the top of the cell and the rest on the sides, the lowest pair forked. Large oblong *avicularia*, with a rounded mandible, distributed amongst the cells. *Oæcia* rounded, finely granular.

HABITAT. On stones, coral, &c., from deep water.

LOCALITY. Shetland (Barlee): "a very interesting and very rare species;" 100 fathoms, Outer Haaf (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. On *Oculina* from 200–300 fathoms, off the coast of Norway (Baron Uggla).

This species is readily distinguished by the two forked spines bending inwards over the lower part of the aperture, and by the character of its *avicularia*, which are of the Flustrine type, and have a semicircular mandible, a form which occurs on only one other British species, *M. flustroides*. They are numerous, and are distributed amongst the cells, and on the same plane with them, instead of being developed upon them as secondary formations.

In old and worn specimens, from which all the membranous portions have been removed, a curious appearance is presented by the upper part of the aperture, which is marked off by a calcareous rib, and divided into two compartments (Plate XXII. fig. 3). This peculiarity is usually concealed by the oral valve; but when visible, it changes materially the aspect of the species.

MEMBRANIPORA ROSSELI, Audouin.

Plate XXII, fig. 4.

FLUSTRA ROSSELI, *Aud.* Expl. 240: *Savigny*, Egypte, pl. x. fig. 11.MEMBRANIPORA ROSSELI, *Busk*, B.M. Cat. ii. 59, pl. c. fig. 2: *Hincks*, Devon Cat. 38 (sep.): *Heller*, Bryoz. Ad. Meer. 20: ?*Manzoni*, l. c., Contr. 4, 11, pl. iii. fig. 15.

Zoœcia oval, or elongate, wide and arched above, contracted below, and either truncate or pointed at the lower extremity, very regularly quincuncial; a minutely granulated lamina filling in more than half the area; aperture longer than broad, arched above, widest below, and contracted towards the top, lower margin straight or slightly curved inwards; margin of the cell much raised, especially above the aperture, finely beaded.

Oœcia flattened in front. *Avicularia* none.

Colonies forming very flat, closely appressed, neat-looking brownish crusts, often of large size.

RANGE OF VARIATION. There are considerable differences in the shape of the zoœcium, which is sometimes pretty regularly oval; but more commonly it exhibits a rudely lozenge-shaped figure, elongate, and rather narrow in proportion to its length, arched above, where it is widest, contracting from about the middle downwards, and terminating below in a truncate or pointed extremity. The margin is generally more elevated above the aperture than elsewhere, and sometimes forms a very thick and prominent wall at this point. The aperture usually occupies decidedly less than half the area, but in some cases a rather larger proportion.

HABITAT. On shells (chiefly) and stones, from shallow to deep water.

LOCALITIES. Orkney (*Busk*): Shetland, on stones, Outer Haaf, 80–140 fathoms (A. M. N.): Isle of Man, off Maughold Head; Torbay, forming large patches on

shell; Guernsey (T. H.): Antrim (Hyndman): Peterhead and Wick (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Algiers (J. Y. J.): Bay of Gibraltar (M'Andrew and Landsborough): Adriatic, on *Tellina depressa* (Heller).

MEMBRANIPORA TRIFOLIUM, S. Wood.

Plate XXII. figs. 5, 6.

FLUSTRA TRIFOLIUM, *Searles Wood*, Ann. N. H. ser. 1, xiii. 20.

MEMBRANIPORA TRIFOLIUM, *Busk*, Crag Pol. 32, pl. iii. figs. 1, 2, 3, and 9 (part.).

MEMBRANIPORA SOLIDA, *Packard*, Labrador Anim. (1860), 8, fig. 2.

MEMBRANIPORA SACCULATA, *Norman*, Ann. N. H. ser. 3, xiii. (1864), 88 (8 sep.), pl. xi. fig. 3.

MEMBRANIPORA FLEMINGII, forma TRIFOLIUM, *Smitt*, Œfv. K. Vetensk.-Akad. Förh. 1867, no. 5; Krit. Förteckn. pt. iii. 367 and 405, pl. xx. fig. 42.

Zoæcia lozenge-shaped, or ovate, or elongate, arched and wide above and narrowed downwards; the lower part of the area covered in by a thin, minutely granular lamina; aperture ample, trifoliate; margin elevated, crenated. *Avicularia* sparingly developed, raised, placed between the cells; mandible acute, directed upwards or downwards. *Oæcia* semielliptical, smooth, but having on the front a triangular space, bordered by a raised line, which is minutely granular.

Colonies of a pale olivaceous-green colour.

Var. *a* (*quadrata*). Margin of the cells very prominent and strongly crenated, rarely two spines at the top, one on each side. Occasionally a prominent *avicularium* on the lamina, near the bottom of the cell, placed obliquely; mandible pointing downwards and outwards. *Oæcia* globose, bordered in front by a raised line, inclosing a somewhat quadrangular space, which is minutely granulated.

Colonies forming subcircular, reddish-brown crusts.

RANGE OF VARIATION. There are very considerable differences in the form and proportions of the cells, corresponding generally with those which I have already described in *M. Rosselii*. The lozenge-shape predominates; but the elongate form, wide and arched above, and narrowing off from an angle on each side about the middle of the cell, is far from uncommon.

The variety α differs from the typical form as described by Norman chiefly in the character of the ovicell. The avicularium, too, is situated *on the lamina* instead of between the cells; and the margin is more strongly developed and coarsely beaded.

HABITAT. Incrusting shells and stones in shallow and deep water.

LOCALITIES. Shetland, common, 40–170 fathoms (A. M. N.): Wick, var. α (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. South Labrador (Packard): St. Lawrence (Dawson): Bahusia, common, 10–100 fathoms (Smitt): Spitzbergen, Röde-Bay, 40 fathoms (Goës): Greenland, Holsteinborg Harbour, 7–35 fathoms ('Valorous' dredgings): Bergen (A. M. N.).

RANGE IN TIME. Coralline Crag, very abundant on *Terebratula grandis* and other shells (S. W.): Red Crag (A. Bell).

The present species is closely allied to *M. Rosselii*. In the absence of the ovicells and of the avicularia, which are very sparingly developed, there may be some difficulty in distinguishing the two. In the latter the surface of the zoarium is flatter, and neater in appearance than in *M. trifolium*, the zoëcia are smaller and narrower, the aperture generally occupies a smaller proportion of the area, the margin is more elevated round the top of the cell, the lamina is thicker and more depressed. In *M. tri-*

folium the lamina is tumid, thin, and glistening; the cells are commonly rhomboidal or lozenge-shaped, but, as I have mentioned, there are many variations, and there seems to me to be less difference in this respect between the two forms than Mr. Norman supposes. There is usually no trace whatever of spines; but on a small colony from Wick, two are present at the top of the cell, placed one at each side.

There can, I think, be no doubt as to the identity of *M. sacculata*, Norman, with the Crag species *M. trifolium*. In the figures of the latter in Busk's Monograph, the same differences in the position of the avicularia are represented as we find in the recent form (compare figs. 1 and 3 on plate iii.).

MEMBRANIPORA MINAX, Busk.

Plate XXII. figs. 2, 2a, 2b, 2c.

MEMBRANIPORA MINAX (*rhyncota* in the description of the plate), Busk, Zooph., Quart. Journ. Micr. Sc. viii. (1860), 125, pl. xxv. figs. 1, 1a, 1b (not *M. rhyncota*, Crag Polyzoa).

MEMBRANIPORA FLEMINGII, forma MINAX, Smitt, Öfv. Kōngl. Vet.-Akad. Förhandl. 1867, no. 5, 367 and 409, pl. xx. fig. 43.

Zoæcia pyriform, narrowed below; area occupying about half the front of the cell, oval, inclosed by a much raised, wall-like margin with a thin edge, two long spines on each side near the top; lamina smooth; aperture obscurely trifoliate, occupying about two thirds of the area; a large, raised, central *avicularium* placed transversely on the margin at the bottom of the area, or immediately below it, with a long and slender mandible, tapering to a very fine point. *Oæcia* small, subimmersed, globular, minutely granular.

Primary cell Tata-like, with eleven or twelve, or sometimes with only five or six erect spines round the margin of the circular or elliptical area (*Smitt*).

HABITAT. On stones and shells in deep water.

LOCALITY. Shetland (Barlee) : *ibid.*, in 40–170 fathoms, common ; “ the most abundant species in deep water, it encircles the dead shells of *Dentalium* and *Ditrupa* with its polyzoary ” (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Finmark (Lovén) : East Greenland (North Germ. Polar Exped.) : Bergen (A. M. N.).

In the original account of this species the name *rhyncota* found its way through some oversight into the description of the figures. Of course, the name in the text would naturally have precedence ; and Mr. Busk has since given the other to a very different species, in his ‘ Monograph of the Crag Polyzoa.’

Smitt seems to have confounded two very distinct forms under his *M. Flemingii* forma *minax*. The one represented in his plate xx. fig. 44, with the remarkable avicularium recalling that of *Bugula Murrayana*, can hardly be referred to Busk’s species.

MEMBRANIPORA NODULOSA, Hincks.

Plate XX. fig. 9.

MEMBRANIPORA NODULOSA, *Hincks*, Ann. N. H. ser. 4, xx. 213 (Sept. 1877).

Zoæcia small, oval, separate ; margin continuous, slightly raised, granular, unarmed ; more than half the area covered in by a minutely granular calcareous lamina ; aperture occupying rather more than a third of the area, arched and somewhat contracted above, lower margin almost straight ; at the base of each cell a very large, prominent, smooth nodule, usually subtriangular in shape.

Oæcia very small and shallow, rounded, smooth.
Colonies forming small and very inconspicuous crusts.

RANGE OF VARIATION. Only two or three specimens have been examined; and they exhibit very little variation, except in the size of the nodules, which constitute so striking a feature of the species.

HABITAT. Shells from about 30 fathoms and from deeper water.

LOCALITIES. Off the coast of Antrim (Hyndman): South Devon, off Brixham (T. H.).

This species is at once distinguished from *M. Rosselii*, perhaps its nearest ally, by the much smaller size and oval form of the cell, the continuous and very slightly granular margin, and the large and conspicuous inter-cellular bosses or nodules.

Genus MEGAPORA, *Hincks*.

Der. From μέγας, large, and πόρος, an opening.

LEPRALIA (part.), Busk.

MEGAPORA, Hincks, ANN. N. H. 1877.

GENERIC CHARACTER.—ZOARIUM *incrusting*. ZOÆCIA *with a depressed area in front, surrounded by a raised margin, and partially closed in by a calcareous lamina; aperture trifoliate, the lower portion filled in by a horny plate, on which the opercular valve works.*

THIS genus is instituted for the remarkable form described by Busk as *Lepralia ringens*. It exhibits many points of resemblance to some of the *Membraniporæ* (e. g. *M. Flemingii*), and should certainly, I think, be included in the present family.

It holds its separate place and name by virtue of the peculiar structure of the aperture.

MEGAPORA RINGENS, Busk.

Plate XXII. fig. 1.

LEPRALIA RINGENS, *Busk*, Quart. Journ. Micr. Sc. iv. (1856), Zoophytol. 308, pl. ix. figs. 3-5: *Norman*, Shetland Pol., Rep. Brit. Assoc. 1868, 307.

MEGAPORA RINGENS, *Hincks*, Ann. N. H. ser. 4, vol. xx. 529.

Zoæcia ovate, with an inclosed area, which occupies the upper portion of the front surface; surface minutely pitted; orifice trifoliate, arched above, much contracted below the middle, and expanded at the bottom into a transverse fissure-like compartment, which is filled in by a fixed horny plate, distinct from the movable oral valve; marginal spines 4-6; on the front or side of the cell a tall corneous vibraculoid spine. *Oæcia* small, globose, smooth, with a raised central rib passing from the front margin backwards.

Colonies growing in small inconspicuous patches of irregular shape.

HABITAT. On stones from deep water.

LOCALITIES. Shetland (Barlee): *ibid.*, 80-170 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.).

Family IX.—**Microporidæ.**

MICROPORIDÆ, Smitt, Floridan Bryozoa.

MEMBRANIPORIDÆ (part.), Busk.

ZOÆCIA *with the front wall wholly calcareous; margins elevated.*

THIS family is distinguished by the total disappearance of

the membranous area on the front of the cell, a character in which it agrees with the forms grouped under the old genus *Lepralia*; while, on the other hand, the elevated margin of the zoëcium indicates its affinity with the *Membraniporæ*.

Genus MICROPORA, Gray.

Der. From μικρός, small, and πόρος, an opening.

FLUSTRA (part.), Johnston.

DISCOPORA (part.), Lamarek.

MICROPORA, Gray, B.M. Rad. 115: Smitt.

MEMBRANIPORA (part.), Busk, &c.

LEPRALIA, sp., Norman: Reuss.

REPTESCHARELLINA (part.), D'Orbigny.

GENERIC CHARACTER.—ZOARIUM *incrusting*. ZOËCIA *with prominent raised margins; front depressed, wholly calcareous; orifice semicircular or suborbicular, inclosed by a calcareous border*.

IN this genus the zoëcia agree with those of *Membranipora* in the possession of a raised margin and depressed front; but there is no trace left of the membranous covering, while the orifice, which is placed at the very top of the cell, is bounded above and at the sides by the margin of the wall, and below by a calcareous rib or border. Avicularia are present in some species, and wanting in others.

Besides the three species described in this work, a considerable number of *Membraniporæ*, both fossil and recent, must be referred to this group.

Several Miocene forms have been recorded; and the generic type is as old as the Chalk at least.

MICROPORA CORIACEA, Esper.

Plate XXIII. figs. 5-7.

FLUSTRA CORIACEA, *Esper*, Pflanz. Flustr. pl. vii. fig. 2.DISCOPORA CORIACEA, *Lamk.* An. s. Vert. ed. 2, ii. 251.MICROPORA CORIACEA, *Gray*, B.M. Rad. 115: *Smitt*, Flor. Bryoz. pt. ii. 13, pl. iii. fig. 74.MEMBRANIPORA CORIACEA, *Busk*, B.M. Cat. ii. 57, pl. lxxiii. figs. 4, 5.

Zoæcia broadly elliptical or rhomboidal; margin slightly roughened, terminating above on each side in a smooth claviform knob; area minutely granular and punctate, frequently with a foramen on each side a little below the mouth; orifice broader than long, arched above, lower margin straight, pouting. Occasionally an *avicularium* immediately above the orifice, placed somewhat obliquely, mandible directed upwards. *Oæcia* large, subimmersed, minutely granular, with a projection or rib in front.

RANGE OF VARIATION. The foramina in the front wall are frequently wanting; but in some colonies they are present on almost every cell, and give a very marked character to the specimen. Occasionally the tuberosities, which form so striking a feature of the species, attain an enormous growth. The avicularia seem to be rarely developed. There is always a projection or callosity on the front of the ovicell; but it varies considerably in character, being in some cases a massive umbo, in others forming a smooth, thickened area, arched, or rising to a blunt point above, and with a rib-like border, and in others, again, assuming the shape which is represented in Plate XXIII. fig. 7.

HABITAT. On shells, stones, &c., from tide-marks to very deep water.

LOCALITIES, Shetland, under stones between tide-marks;

the Minch (A. M. N.) : Antrim ; off Sana Island (Hyndman) : Cornwall, deep water ; Guernsey (T. H.) : Hastings (Miss Jelly) : Caithness ; Aberdeenshire (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Florida, 36-135 fathoms (Pourtales).

MICROPORA COMPLANATA, Norman.

Plate XXIII. figs. 8, 9.

LEPRALIA COMPLANATA, *Norman*, Ann. N. H. January 1864, 84, pl. x. fig. 4.

MEMBRANIPORA SMITTH, *Manzoni*, Bryoz. foss. Ital. Contr. 4, 11, pl. iii. fig. 16 (Sitzb. K. Akad. d. Wissensch. Bd. lxi. 1. Abth. März-Heft, 1870).

Zoæcia lozenge-shaped, flattened, quincuncially arranged ; marginal lines smooth ; surface thickly covered with rather large punctures ; mouth semicircular, well arched above, slightly contracted on each side below, the upper margin usually thickened and produced into a point, unarmed, lower lip nearly straight, pouting. *Oæcia* depressed, in the form of a quarter-moon, smooth.

Colony forming a white, glossy crust.

HABITAT. On shells and stone.

LOCALITY. Unknown. Mr. Norman's specimens were found without label amongst Mr. Barlee's extensive collection. They occurred on shell, and "in the little hollows of a rounded and much water-worn piece of coarse-grained granite."

RANGE IN TIME. Italian Pliocene deposits (Manzoni).

Membranipora Smitthii of Manzoni is clearly identical with the present species. But in the fossil there is always a small callosity on each side near the lower corners of the mouth, which is rarely developed in the recent form ; it

does occur, however, occasionally, though never such a striking feature as it is represented in Manzoni's figure.

The mouth has an obscurely trifoliate appearance, which is due to a slight marginal projection on each side, almost immediately above the lower lip. This constitutes an important difference between the present species and *M. coriacea*. Another is found in the thickened border, more or less pointed above, surrounding the upper margin of the orifice. The area is also much more thickly punctured than in *M. coriacea*; and the punctures are of larger size.

Genus STEGANOPORELLA, Smitt.

Der. Dim. of *Steganopora* (στεγανός, covered, and πόρος, an opening),
a genus of Polyzoa.

MEMBRANIPORA (part.), auctt.

REPTESCHARELLINA (part.), D'Orbigny.

STEGINOPORELLA, Smitt, Flor. Bryoz.

GENERIC CHARACTER.—ZOARIUM *incrusting or (occasionally) rising into foliaceous expansions**. ZOÆCIA *with the external characters of Micropora, but having an inner chamber occupying the whole of the cavity below, and above narrowed into a tubular passage, which either communicates directly with the orifice or opens into a second chamber immediately beneath it.*

THE species in which the characters of this group are most strikingly exhibited is the *Membranipora magnilabris*, Busk. In some respects, however, it is peculiar; and we have a better average representative of the genus in our British species.

* According to Smitt, *S. magnilabris*, Busk, sometimes assumes this condition (Flor. Bryoz. pt. ii. pl. iv. fig. 100).

In external appearance the cell of *Steganoporella* resembles very closely that of *Micropora* ; but in many cases the large foramina in the front wall allow the neck-like termination of the lower chamber to be seen, and so reveal the structural difference between them.

At a short distance from the upper extremity of the zoëcium a diaphragm shuts off the lower portion of the cavity, and forms a chamber in which the polypide is lodged. From the centre of this diaphragm a tubular prolongation passes upwards to the opening of the cell (in *S. Smittii*), and is there closed by the opercular valve. In *S. magnilabris* this tubular passage (through which the polypide issues from its dwelling) opens into a large chamber occupying the upper portion of the cell, and probably oöcial in character, which is closed in by an operculum of unusual size and structure.

The peculiarities of the last-named species connect themselves with the remarkable modification of the ovicell, which has no existence in other members of the group. In *S. Smittii*, for instance, the oöcium is of the ordinary kind ; the upper chamber is wanting, and the tubular passage from the lower chamber extends to the orifice of the cell (woodcut, fig. 7).

Fig. 7.



Sections of the zoëcium.

The name selected for this generic group is intended to connect it with the *Steganopora* of D'Orbigny, but there seems to be no real analogy of structure between the two.

STEGANOPORELLA SMITTH.

Plate XXIV. figs. 5, 6.

MEMBRANIPORA ANDEGAVENSIS, *Busk*, Crag Pol. 35, pl. ii. figs. 5 & 9 (probably not *Eschara Andegavensis* of Michelin).

Zoæcia large, elongate, subquadrangular, slightly arched above; margins granular, the front wall punctate, rising somewhat abruptly towards the orifice, an oval foramen in a recess on each side a little below the mouth; orifice suborbicular, contracted below by a small projection on each side, with the lower lip slightly curved outwards; the upper margin thickened, the lower thin. *Avicularia* distributed amongst the zoæcia, placed on an area nearly as large as the cell, which is arched above and pointed below; mandible of a dark horn-colour, occupying nearly two thirds of the area, flat, contracted towards the point of attachment, expanded and rounded above, strengthened by a narrow central plate. *Oæcia* ample, rounded, very broad (much broader than high), flattened at the top, smooth, carinate in front, with a large arched opening closed by a horny movable lid. Colony forming a thin whitish crust.

HABITAT. On the tube of an Annelid from deep water.

LOCALITY. Off the Cornish coast, incrusting a *Serpula* (C. W. P.).

RANGE IN TIME. Coralline Crag, on shell (Searles Wood).

For this fine addition to our fauna we are indebted to Mr. Peach, who has obtained it on two occasions from the Cornish coast.

There can be no doubt as to the identity of the British specimen which I have examined with the Crag fossil; but I can hardly agree with Mr. Busk in referring the

latter to Michelin's *Eschara Andegavensis*. His figure exhibits none of the peculiarities of the present species, and is more probably, I think, a representation of the common Mediterranean form (also found in Tertiary deposits), which has been described under various names, but was first characterized by Moll as *E. impressa*.

The zoecia are subquadrate, the opposite walls being almost parallel. The front wall is somewhat depressed below, but rises rather abruptly towards the inferior margin of the orifice. On each side of its elevated portion, which marks the course of the tubular entrance to the inner chamber, are placed the foramina. They are sometimes met with overspread with a delicate membrane, and are not unfrequently obliterated by age and the progress of calcification. They open into the space lying between the outer walls and the tubular neck of the chamber.

On the Cornish specimen the very curious avicularia are present in great numbers, and, from their size and the dark colour of the mandible, are very conspicuous objects. The area on which they are placed is large, almost equalling in size that of the cells. It narrows off to a point below; and about the middle the aperture is contracted by a projection of the margin on each side, which bends over it, forming with the arched top of the area a kind of frame round the mandible. The latter is flat, and is traversed for about two thirds of its length by a narrow band or rib, which is formed of stronger material than the rest. In Mr. Busk's type specimen from the Crag the avicularia are also numerous; and in two cases the mandible has been preserved, showing very clearly the characteristic structure which I have just described.

The ovicell is of unusual size, and exhibits a curious peculiarity in the horny lid which closes the large arched

aperture. This lid falls like a trap-door, and when down covers a considerable portion of the front of the cell. In the ovicelligerous cells the orifice is larger than in the ordinary zoëcia, and of different form. There is a close resemblance between the oëcia of the present species and those of *S. Rozieri*, Audouin.

Genus SETOSELLA, *Hincks*.

Der. A dim. formed from *setosa*, bristly.

MEMBRANIPORA (part.), Busk.

CUPULARIA (part.), Smitt, Floridan Bryoz. ii. 14.

SETOSELLA, Hincks, Ann. & Mag. N. H. Sept. 1877.

GENERIC CHARACTER.—ZOARIUM *incrusting*. ZOËCIA *with raised margins; front depressed and wholly calcareous; aperture semicircular*. VIBRACULAR CELLS *alternating with the zoëcia throughout the colony*. VIBRACULUM *slender and setiform*.

IN this genus each of the zoëcia has a vibracular cell immediately above it; the vibraculum is of the more highly specialized type, and exhibits no trace of the fixed beak-like structure which is found in connexion with the more rudimentary transitional forms. The zoëcia agree in general character with those of *Micropora*.

There is also a resemblance between *Setosella* and *Cupularia*, Busk, in the mode in which the vibracular cells are distributed over the colony; and Smitt would unite the two forms in one generic group. As I cannot subscribe to his fundamental principle, that the plan on which the cells are associated in the zoarium is of no account as a generic

character, I am unable to assent to this view. The remarkable structure of the zoarium in *Cupularia*, and its free condition when adult, are points of much systematic value ; and to these must be added the great development of the vibracula, and their (probable) assumption of a locomotive function*.

SETOSELLA VULNERATA, Busk.

Plate XXI. fig. 7.

MEMBRANIPORA VULNERATA, *Busk*, Quart. Journ. Micr. Sc. viii. (1860), 124, pl. xxv. fig. 3: *Norman*, Shetl. Dredging Rep., Brit. Assoc. Rep. 1867, 305.

SETOSELLA VULNERATA, *Hincks*, Ann. & Mag. N. H. for Dec. 1877.

Zoæcia somewhat pyriform or oval ; margin slightly raised, smooth, unarmed ; orifice small, arched above, the lower lip a little curved outwards ; lamina minutely granular, rising rather abruptly towards the mouth, usually with a narrow, slit-like fissure, slightly curved, on each side, a little below the orifice. Long and slender *vibracula* distributed over the colony on distinct intercellular areas, one immediately above each cell. *Oæcia*?

Colonies forming very small, white, subcircular patches.

RANGE OF VARIATION. There are sometimes considerable differences in the size of the cells within the limits of the same colony. The shape varies from suboval to pyriform ; the cells are generally much narrowed towards the orifice, and expand to a moderate degree below. The lateral fissures in the lamina are occasionally wanting.

* Mr. Busk informs me (*in litt.*) that his conjecture respecting the locomotive function of the vibracula amongst the family of *Selenariade* (to which *Cupularia* belongs) has been confirmed by actual observation.

HABITAT. Very small stones in deep water. Mr. Norman says:—"This very distinct little species has a very peculiar habit; it is never found on any but the smallest stones. I do not remember to have *ever* seen it on a pebble larger than the little-finger nail; more generally it selects those that are not more than a fourth of that size."

LOCALITY. Shetland (Barlee): *ibid.*, in 80-110 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.).

In this species the vibracula seem to be always present, alternating regularly with the zoœcia throughout the colony. They reveal very clearly their homological nature, as modifications of the ordinary cell. The vibracular cell is in many respects a copy in miniature of the zoœcium, presenting the raised margin, the lamina, and the equivalent of the orifice, the setiform appendage taking the place of the oral valve.

Family X.—Cribrilinidæ.

ESCHARIDÆ (part.), Johnston.

MEMBRANIPORIDÆ (part.), Busk.

ESCHARIPORIDÆ (part.), Smitt.

ESCHARELLIDÆ (part.), D'Orbigny.

ZOARIUM *adnate, forming an indefinite crust, or erect.*
 ZOÆCIA *having the front wall more or less fissured, or traversed by radiating furrows.*

THE *Cribrilinidæ* form a section of the large and miscellaneous assemblage of forms included in the genus

Lepralia of Johnston. That the latter is a very heterogeneous group, and cannot be maintained in its integrity, will probably be admitted by most. There will be less agreement as to the principles on which it should be subdivided, and the constitution of the new genera that are to replace it. Our knowledge of the *Polyzoa* is not yet sufficient to admit of a strictly natural classification, and our arrangement of them must still be, to a large extent, more or less artificial; and to some it may appear hardly desirable to interfere with the existing order of things for the sake of a change which, after all, may be merely provisional. But it must be borne in mind that, as a matter of convenience, and to facilitate the work of the student, it is essential that the unwieldy collection of forms bearing the name *Lepralia* should be broken up into groups of some kind or other; and it seems better to aim at a natural subdivision, even though the attempt should be only partially successful, than to perpetuate the purely arbitrary method hitherto in use.

Of the numerous species ranked under the genus *Lepralia*, many have little in common but general habit; and to mass them together indiscriminately can only be accounted a very rude and provisional kind of classification.

I am very sensible of the difficulties—some of them, I fear, insurmountable for the present—which are attendant upon the work of reorganization in this department, even after the valuable labours of Prof. Smitt*. My aim has been to form groups which shall represent the more important variations in the architecture and structural composition of the zoecium. The other principal zooidal

* See his paper entitled "Bryozoa marina in regionibus arcticis et borealibus viventia recensuit F. A. Smitt," *Cefv. Kongl. Vetenskaps-Akademien's Förhandlingar*, 1867, no. 6, p. 443.

element in the Polyzoon colony—the polypide—does not exhibit any differences amongst the *Lepraliæ* that can be employed as diagnostic characters in the construction of genera. The avicularian appendages constitute in the present section a very unstable and variable element, and are of very secondary value for systematic purposes. In the plan of the gemmation and the colonial habit there is on the whole much uniformity; but the important and difficult question arises, whether forms of kindred zoëcial character, but exhibiting an erect mode of growth, should be combined in one genus with those which are crustaceous. This and other systematic points are discussed in the section of the Introduction devoted to the subject of Classification.

The present family is a very natural and well-defined group.

Genus CRIBRILINA, Gray.

Der. From *cribrum*, a sieve.

CELLEPORA (part), Fabricius.

ESCHARA (part.), Moll.

LEPRALIA (part.), Johnston : Busk.

CRIBRILINA, Gray, B.M. Rad. 147 : Smitt, Floridan Bryoz. pt. ii.

REPTESCHARELLA, D'Orbigny, Pal. Franç. Terr. Crét.

ESCHARIPORA, Smitt, Cefv. Kongl. Vet.-Ak. Förhandl. 1867, Bihang.

GENERIC CHARACTER.—ZOARIUM *incrusting*. ZOECIA *contiguous, having the front more or less occupied by transverse or radiating punctured furrows; orifice semicircular or suborbicular*.

THE peculiar condition of the front of the zoëcium, which distinguishes this genus, has a special significance. It is not a mere variety of superficial sculpture, but

depends on the primary composition of the cell-wall, and indicates the course of its development. The ridges radiating towards the centre represent the rib-like processes given off from the margin of the young cell, as in the genus *Membraniporella*, which ultimately meet and form a protective covering. These ridges are united laterally by outgrowths of stony matter occurring at intervals; and the spaces between the connecting links are represented by the interstitial punctures of the adult organism. So that the genus is founded not on any trivial peculiarities, but on the essential structure of the cell itself.

Cribrilina marks a transitional stage in advance of that represented by *Membraniporella*.

A considerable number of fossil species are known, some of which reach back to the Cretaceous deposits.

CRIBRILINA RADIATA, Moll.

Plate XXV. figs. 1-9.

ESCHARA RADIATA, *Moll*, *Seerinde*, 63, pl. iv. fig. 17.

LEPRALIA INNOMINATA, *Couch*, *Corn. Faun.* iii. 114, pl. xxii. fig. 4 (worthless): *Johnston*, *Br. Z.* ed. 2, 319, pl. lv. fig. 12: *Busk*, *B.M. Cat.* ii. 79, pl. lxxxvi. figs. 2, 3: id. *Crag Pol.* 40, pl. iv. fig. 2: *Hincks*, *Devon and Corn. Cat.*, Ann. N. H. ser. 3, ix. 203 (p. 43 sep.): *Manzoni*, *Suppl. Bryoz. Medit. prima Contr.* 4, pl. i. fig. 5 (*Sitzb. k. Akad. d. Wissensch.* Bd. lxiii. 1. Abth. Feb.-Heft, 1871); *Bryoz. Pliocen. Ital. prima Contr.* 8, pl. ii. fig. 13 (*Crag form*).

? FLUSTRA POUILLETII, *Audouin*, *Savigny, Egypte*, pl. ix. fig. 12.

? LEPRALIA MULTIRADIATA, *Reuss*, *Oberburg*, 31, pl. x. fig. 5; *Paläontol. Studien*, ii. 43.

LEPRALIA SCRIPTA, *Reuss*, *Sitzungsb. k. Akad. d. Wissensch.* Bd. 1. 28, pl. xv. fig. 3; *Bryoz. d. deutsch. Septarienth.* 1866, 58; (*Cellepora*), *Polyp. d. Wiener Beckens*, 82, pl. ix. fig. 28: *Manzoni*, *Suppl. &c.* 5, pl. i. fig. 6.

LEPRALIA PRETIOSA, *Reuss*, *Bryoz. d. deutsch. Septarienth.* 59, pl. viii. fig. 4.

LEPRALIA CALOMORPHA, *Reuss*, *l. c.* 62, pl. xi. fig. 10.

LEPRALIA RARICOSTATA, *Reuss*, Foss. Bryoz. österreich-ungarisch. Miocän, 26, pl. i. fig. 8.

? LEPRALIA ENDLICHERI, *Reuss*, l. c. 31, pl. i. fig. 9.

REPTESCHARELLA PYGMÆA, *D'Orb.* Pal. Franç. Terr. Crét. v. 468, pl. 716. figs. 7, 8.

? REPTESCHARELLA RADIATA, *D'Orb.* op. cit. v. 468, pl. 716. figs. 4-6.

CRIBRILINA RADIATA, *Smitt*, Floridan Bryoz. pt. ii. 22, pl. v. figs. 107, 108.

CRIBRILINA INNOMINATA, *Smitt*, l. c. 22, pl. v. figs. 109, 110.

LEPRALIA ANNULATA, *Heller*, Bryoz. Adriat. M. 33: *Manzoni*, Suppl. Faun. Bryoz. Medit. prima Contr. 4, pl. i. fig. 4.

? LEPRALIA CRIBRILLINA, *Manz.* Brioz. di Castrocaro, 27, pl. iii. fig. 40.

Zoæcia oval, sometimes subglobose, distinct, quincuncially arranged, with six to nine ridges on each side, radiating from a central line, the furrows between them occupied by a row of minute punctures, often a more or less prominent keel down the centre, terminating in an umbo above; orifice semicircular, the lower margin straight, on each side of it a very delicate setiform appendage, often wanting; immediately below it a projecting triangular area, bounded by raised walls and inclosing a subtriangular pore (form i.), or an umbo and a few large punctures only (form ii.); marginal spines 5-6. *Avicularia* elongate, with pointed mandible, scattered amongst the zoæcia. *Oæcia* globose, with a keel down the front.

Colonies forming large irregular crusts, sometimes white or silvery.

Var. α . Cells very small, radiating ridges five, two on each side and one at the bottom, very prominent, the two uppermost forming a wall across the face of the cell; median pore present; two slender vibraculoid *setæ*. *Oæcium* with many nodulous projections on the front.

Var. β . Cells very minute, distinct, oval, with deep sutures between them, of a delicate pearly whiteness; the front flattish, traversed by ten radiating ridges, which are surrounded by a narrow border of smooth cell-wall; ridges not prominent, interstitial punctures distinct; no central pore or umbo; immediately below the mouth a number of punctures of various shapes and sizes. (Plate XXV. fig. 4.)

Var. γ (*tenuirostris*). With the avicularium developed on a distinct cell; mandible short, broad at the base, much attenuated above.

RANGE OF VARIATION. After careful consideration I have united the *Eschara radiata*, Moll, and the *Lepralia innominata*, Johnston, as one species. The chief difference between them is that one of them has the large pore below the orifice, and the other wants it; but this is far from being a constant distinction between these two forms, and cannot be used in this case as a specific criterion. It must be remembered that specimens which exhibit most strikingly the differences between the *radiata* and *innominata* types are connected at all points by very numerous intermediate and transitional forms, in which the elements of the two are variously mingled and combined. In a specimen before me, presenting the general characteristics of *radiata*, the triangular area below the orifice is present, but not perforated. The *Lepralia pretiosa*, Reuss, which is referable to the same type, is furnished with the median pore. In *Lepralia varicostata*, Reuss, a very well-marked example of the *innominata* type, the pore is wanting. In the *Lepralia Endlicheri*, Reuss, which I am inclined to refer to the same series, the pore is present on some cells and absent on others. The form from Madeira, which Busk figures (Quart. Journ. Micr. Sc. vi. pp. 128 & 263, pl. xx. fig. 4) as *L. radiata*, and which undoubtedly exhibits many of the characteristics of Moll's species, has the median pore well developed! The *L. innominata* of Manzoni from the Mediterranean seems to be somewhat intermediate between the two varieties; it wants the median pore. In other respects the two forms pass insensibly one into the other. The differences, too, which lie chiefly in texture, the more or less

pronounced condition of certain parts (*e. g.* the radiating ribs, the central line, the umbo), are of slight importance, while the leading features are common to both and constant*.

C. radiata, as now defined, exhibits a wide range of variation in what may be called its secondary characters. The cells are sometimes much rounded and widened below, sometimes regularly ovoid; frequently they are produced below into a point; they also vary much in size. The inclosed triangular space below the mouth is more or less marked; at times it is altogether absent; but there is always a smooth space between the inferior margin and the ribs. The median pore is sometimes wanting; when absent there are usually two or three large punctures just below the mouth. In certain fossil varieties there is a blunt tubercle on each side of the central pore.

The zoarium also varies much in its general appearance. In some cases (*radiata* form) it is of extremely delicate texture, silvery and shining; in others (*innominata* form) it is of much coarser make, and of a brownish colour. The area traversed by the radiating furrows is larger or smaller, ovate or subcircular, at times surrounded by a very considerable tract of smooth cell-wall. The umbo, below the orifice, is in some cases largely developed, in others abortive. The same is the case with the central keel. In some forms it all but disappears, and the furrows seem almost to pass continuously from side to side. The ridges or ribs are often very inconspicuous, while in other cases they are strongly defined, radiating from a distinct keel, and standing out prominently round the edge of the area.

* "I have some doubts whether these two (*L. innominata*, Johnst., and *L. radiata*, Moll.) may not, strange as it may seem, prove to be varieties of each other, in which case Moll's name will, of course, have precedence."—Busk, Zoophytology, Quart. Journ. Micr. Sc. viii. p. 283.

They rise up occasionally into erect spinous processes. The interstitial pores are either very distinct (*radiata* form), or almost obliterated (*innominata* form). The small vibraculoid appendages are often wanting. In the avicularium there is a considerable amount of variability. In some cases it is much more elongate than in others, and much more elevated. In a specimen from the Red Sea (?) it is of unusual length, rather blunt at the extremity, and almost pedunculate. In British examples it is usually shorter and broader. A more remarkable modification occurs in a specimen of the *radiata* type from Madeira, in which the avicularium is developed on the upper part of a distinct cell, of much smaller size than the ordinary zoecia, but still well marked; the beak is very short, projecting slightly beyond the top of the cell; the mandible is broad at the base, but becomes suddenly attenuated, and tapers off to the extremity.

This form may be regarded as less completely differentiated than that which is commonly met with, in which the avicularian cell is all but aborted, and little is to be seen but the beak and mandible. These differences are clearly of no specific value; but they are interesting as showing us what an unstable element of structure the avicularium is.

It may be mentioned here, that in this species there are a number of large oval foramina round the base of the cells, which are very conspicuous in those that are placed on the edge of the colony.

HABITAT. At low-water mark, and on stones, shells, zoo-phytes, &c. from moderate depths to deep water (175 fathoms).

LOCALITIES. Abundant on the south and south-west coasts of England, ranging to the Isle of Man, west coast of Scotland, Hebrides (the Minch), and Shetland, where,

however, it is scarce; almost absent on the north-eastern coasts. Birterbuy Bay, Connemara (G. S. Brady): Hastings (Miss Jelly): Cornwall, 60 fathoms (*radiata* and *innominata* forms); Guernsey (T. H.): Shetland, scarce, down to 170 fathoms (A. M. N.): Wick, rare (C. W. P.): &c. Var. α . Antrim, deep water (Hyndman).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Moll, Manzoni): Naples, from 6 fathoms to considerable depths (A. W. Waters): Madeira (Busk): *ibid.* (var. *tenuirostris*) (T. H.): Adriatic, pretty common (Heller): Gulf of Florida, 29–175 fathoms (Pourtales): on the Falmouth-Lisbon cable, between N. lat. $47^{\circ} 58'$ and $47^{\circ} 35'$ and in W. long. $7^{\circ} 6'$, from 89–205 fathoms (Sir James Anderson): Roscoff (Joliet): France, S. W. (Fischer).

RANGE IN TIME. French Cretaceous deposits (D'Orbigny): Austro-Hungarian Miocene, abundant; Oberoligocæn and Mitteloligocæn (at Söilingen), rare (Reuss): Coralline Crag (S. Wood): Middle and Upper Pliocene (Coralline and Red Crag) (A. Bell): Italian Pliocene beds (the Crag form) (Manzoni): Boulder Clay, Wick (C. W. P.): Quaternary, Reggio (A. W. Waters).

CRIBRILINA PUNCTATA, Hassall.

Plate XXVI. figs. 1–4; and Plate XXIV. fig. 3.

LEPRALIA PUNCTATA, *Hass.* Ann. N. H. vii. 368, pl. ix. fig. 7, and ix. 407: *Johnston*, B. Z. ed. 2, 312, pl. lv. fig. 1: *Busk*, B.M. Cat. ii. 79, pl. xc. figs. 5, 6, pl. xcii. fig. 4, pl. xevi. fig. 3; Crag Polyz. 40, pl. iv. fig. 1; Quart. Journ. Micr. Sc. iv. 310, pl. xi. figs. 4, 5.

CRIBRILINA PUNCTATA, *Gray*, B.M. Rad. 117.

? LEPRALIA CRIBROSA, *Boeck*, Förh. Vid. Selsk. Christiania, 1861, 50.

ESCHARIPORA PUNCTATA, *Smitt*, Öfv. K. Vet.-Ak. Förh. 1867, Bihang, Krit. Förteckn. iv. 4 & 51, pl. xxiv. figs. 4–7.

Zoæcia subcylindrical, more or less distinct, sometimes

confluent, disposed in lines, the whole front perforated with punctures of varying size and shape, in rows, or sometimes irregularly distributed; orifice transversely oblong, lower margin much thickened, projecting into a prominent mucro; marginal spines four or five, the two foremost curved in fertile cells, meeting across the mouth in front of the oecium; an avicularium on each side of the orifice (sometimes on one side only), with pointed mandible, directed obliquely upwards. *Oæcia* rounded, smooth, and vitreous, sometimes with a strong rib in front, inclosing a triangular space, from which a keel passes off to the base; frequently a raised process immediately behind it supporting a small avicularium; sometimes destitute of the rib and keel, and thickly punctured.

Polypide tall and very delicate, with about 13 tentacles.

Primary cell small, with a large, terminal, orbicular orifice, surrounded by twelve spines.

Colonies forming silvery shining patches when young, much thickened and coarser when old, with a tendency to a subcircular growth. A central group of diminutive cells marks the origin of the colony.

Var. α . With a central umbo, from which ribs pass off to each side, rising into erect processes round the front of the cell, usually a single large pore in each furrow; mucro and marginal spines strongly developed; lateral avicularia in a line with the lower margin of the orifice, the mandible directed straight outwards. *Oæcium* covered with spinous projections, and commonly with a raised avicularium on the hinder part of it.

RANGE OF VARIATION. This is a species of very variable aspect. The changes in its appearance are chiefly due to the greater or less development of various nodulous and other processes on the surface of the cell and ovicell. Perhaps the most remarkable form which it assumes is

that which I have characterized as var. α ; but it appears in a multitude of guises, and in some of them is very unlike its proper self. The cells are usually somewhat elongate, but occasionally short and almost orbicular. The normal arrangement of the punctures is in transverse rows; but the rows are often very inconspicuous, and in many cases the pores are scattered thickly over the surface. Down each side of the cell several erect nodulous processes are not unfrequently ranged, whilst one of larger size is placed centrally at the base. In one very marked variety the punctures are arranged in rows extending from near the margin to an elevated median keel or crest, and occupy an oval space on the front of the cell, which is inclosed by a line of minute raised pores. The lower margin of the orifice is always thickened and more or less mucronate; but in some cases it becomes very massive and bears a broad, projecting expansion in front. At times on the inner margin there is a bifid process. Probably the oecium is more variable in appearance than any other portion of the structure; it is sometimes smooth and silvery, with a raised thickened rib across it in front, rising in the centre into a knob. In some cases it is covered with raised punctures and numerous nodules, and bears a small elevated avicularium at the top; in others, again, it is smooth, and so much immersed as to be hardly visible, the thick and often subtriangular rib alone standing out prominently above the orifice. Occasionally it is elongated and punctured.

The species, it will be seen, is liable to great diversities in what may be called its surface-decoration. In fresh specimens the cells are silvery and bright; but there is more than the usual tendency to thickening and opacity in the older states.

HABITAT. Between tide-marks, on Algæ, stones, &c., and in moderate depths.

LOCALITIES. Very widely distributed on the British coasts. Shetland, tide-marks; the Minch (A. M. N.): South Devon; Ilfracombe; Guernsey; Isle of Man (T. H.): Hastings (Miss Jelly): Birterbuy Bay (G. S. Brady): &c.

GEOGRAPHICAL DISTRIBUTION. North Sea (littoral region, on Algæ) to Bahusia (Smitt): Southern Norway (Boeck): Kara Sea (Nordenskiöld): France, south-west (Fischer).

RANGE IN TIME. Coralline Crag, on shells, abundant (S. Wood): Middle Pliocene beds (Lower and Middle Coralline Crag) (A. Bell).

CRIBRILINA ANNULATA, Fabricius.

Plate XXV. figs. 11, 12.

CELLEPORA ANNULATA, *Fabr.* Faun. Grœnl. 436.

LEPRALIA ANNULATA, *Johnst.* B. Z. ed. 2, 312, pl. lv. figs. 2, 3: *Busk*, B.M. Cat. ii. 76, pl. lxxvii. fig. 1. (Not the *L. annulata*, Heller, Bryoz. d. Adriat. Meeres, 33, which is probably *Cribrilina radiata*.)

? REPTESCHARELLA HEERMANNII, *Gabb & Horn*, Monogr. Polyz., Journ. Acad. Nat. Sc. Philadelphia, v. pt. ii. 137, fig. 20.

ESCHARIPORA ANNULATA, *Smitt*, Öfv. K. Vet.-Ak. Förh. 1867, Bihang, Krit. Fört. iv. 4 and 53, pl. xxiv. figs. 8-10.

Zoæcia regularly ovate, very distinct, convex, produced into a point below, semialternate, obscurely carinate in front, with about six punctured furrows on each side; orifice suborbicular, slightly compressed transversely, with a thickened peristome, projecting in front into a mucro; marginal spines three or (occasionally) four. *Oæcia* globose; very small and inconspicuous, set far back, glabrous, punctured; two spines showing in front of it, which are commonly united so as to form an arch-like rib.

Colonies forming small (often) circular crusts of a reddish colour. The primary cell appears to be normal, but inferior in size to the rest.

RANGE OF VARIATION. *C. annulata* seems to be less variable than any other British species of its genus. The zoëcia exhibit slight differences of shape, being sometimes short, ovate, and well rounded off below, and sometimes elongate and produced into a point. The ridges and central keel are more or less pronounced; and the punctures vary in size; usually they are rather large and transversely oval in form. There are commonly three spines, two lateral and one in the centre of the upper margin; but not unfrequently the latter is replaced by two of smaller size.

HABITAT. On the fronds of *Laminariæ* and other weeds, on the under surface of stones between tide-marks, and on stones and shells from shallow and deep water.

LOCALITIES. Shetland, on *Laminariæ* and stones, shallow water (A. M. N.): Wick (C. W. P.): coast of Ayrshire; Arran; Cumbræ (Landsborough): Lamlash, abundant on *Laminaria* &c; Oban (T. H.): St. Andrews (Dr. M'Intosh): off Sana Island; Antrim (Hyndman): Isle of Man, rare; Cornwall (T. H.).

GEOGRAPHICAL DISTRIBUTION. Eminently a northern form. Greenland (Fabr.): Nova Zembla, 4-50 fms.; Kara Sea (Nordenskiöld): Hammerfäst, 40-60 fathoms (Lovén): Spitzbergen, 3-30 fathoms (Smitt): Bergen, common on *Laminaria* (M. Sars): Labrador (A. S. Packard): Grand Manan, Bay of Fundy, deep water, incrusting shells &c. (Stimpson): Gulf of St. Lawrence (Dawson).

RANGE IN TIME. Scotch Glacial deposits (Geikie).

* "Habitat in fucis et ulvis minoribus, lepadibus et lapidibus marinis haud infrequens." - FABR., Fauna Grœnlandica.

The mode in which the zoëcium is developed in this species is interesting as throwing light on all similar structures, and on the affinities of the genus to which it belongs. In its earliest stage it exhibits the simple Membraniporidan form—the area occupying the entire front, and being closed by a membranous covering. The ribs, which compose the front wall in the adult, are given off on each side as tubular processes from the edge of the nascent cell, and, gradually lengthening, meet in the centre and unite, the line of junction giving the subcarinate appearance to the zoëcium. These tubular girders, which are probably the equivalent of the marginal spines on many of the *Membraniporæ*, are connected at intervals by lateral outgrowths of calcareous matter; and in this way the porous structure of the furrows is produced. This mode of formation may be well studied in the thickened anterior margin of the orifice, which is composed of two tubular pieces, the pointed extremities of which in meeting often bend outwards, and give rise to a central mucro. Sometimes they are not closely welded together, but overlap one another, or remain partially separate so as to give a bifid appearance to the mucro. Occasionally they do not unite at all, but continue permanently free and detached.

The cells of *C. annulata* are not so intimately united as those of most other species. “*Aggregatæ (nec tamen connatæ)*” Fabricius says of them. They lie side by side, but do not blend one with the other. Fabricius describes them as occurring in a solitary condition in Greenland. The walls are formed of very solid substance; and when fresh they are smooth and lustrous.

The marginal spines are of two kinds: the lateral pair are tall, and jointed to a short tubular process; the hinder one is not jointed, but is a stout subconical outgrowth of

the margin itself. The rib, which arches across the front of the ovicell, is composed of the two lateral spines.

This is a very attractive species. Fabricius, in his enthusiasm, could say of it, "Pulcherrima et perfectissima hæc omnium visarum." There are certainly few that surpass it in beauty.

L. puncturata, S. Wood, of the Red Crag, is a nearly allied species, having much closer affinity with *C. annulata* than with *C. punctata*, with which Busk compares it.

CRIBRILINA FIGULARIS, Johnston.

Plate XXVI. figs. 5-7.

LEPRALIA FIGULARIS, *Johnst.* B. Z. ed. 2, 314, pl. lvi. fig. 2: *Gray*, B.M. Rad. 119: *Busk*, B.M. Cat. ii. 80, pl. lxxiii. figs. 1-3: *Hincks*, Devon & Cornw. Cat. 44 (sep.).

ESCHARIPORA FIGULARIS (forma TYPICA auctt.), *Smitt*, Cefv. K. Vet. Ak. Förh. 1867, Bihang, Krit. Fört. iv. 4. (Not *Cribrilina figularis*, *Smitt*, Floridan Bryoz. pt. ii. 23, pl. v. figs. 111, 112.)

Zoæcia ovate, large, sometimes pointed below, the upper portion of the front surface occupied by a raised oval area crossed by five or six ridges, which terminate at each side of the area in prominent papillæ, usually perforated at the apex, the furrows between the ridges minutely punctured; walls of the cell beyond the area smooth and shining; orifice subquadrangular, margin straight above, slightly curved and projecting below, unarmed. *Avicularia* of large size, elongate, with the mandible enlarged and rounded at the upper extremity, distributed over the colony amongst the zoæcia. *Oæcia* globose, smooth, closely united to the cell above, with a keel down the front, terminating above in a knob, and a pyriform fossa on each side.

Var. *α* (*fissa*). The furrows punctured towards the centre of the area, and towards the edge of it traversed by a fissure; area small, not lobed round the margin.

Colonies forming large, irregularly spreading crusts; the

cells distinct to the naked eye. The young, marginal zoœcia vitreous and glistening.

RANGE OF VARIATION. A very beautiful elongate variety occurs, in which the ridges number as many as eighteen. In some cases they are half obliterated, and the area presents a very flat appearance. The avicularia are often absent. Though really a very striking feature of the species, they have not, I believe, been noticed by any author, with the single exception of Heller.

I have met with a curious monstrosity, in which the area was so much reduced in size as only to occupy less than half the length of the cell.

The var. *a* is from Singapore. The fissured surface of the area gives it a very different appearance from the ordinary form; but it exhibits no peculiarity that would warrant its erection into a species.

HABITAT. Occasionally at low-water mark, and on shells and stones from moderate depths to deep water (60 fathoms).

LOCALITIES. Cornwall, 30–60 fathoms; Guernsey, abundant (T. H.): Hastings (Miss Jelly): coast of Antrim, deep water, rare (Hyndman): Birterbuy Bay, Connemara (G. S. Brady).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): Adriatic, not rare, on mussel-shells and Nullipores (Heller).

RANGE IN TIME. Lower Coralline Crag (A. Bell). The *Escharella Arge*, D'Orbigny, of the French Cretaceous deposits, is most nearly related to the present species, so far as the characters of the cell are concerned, but has an erect and apparently foliaceous mode of growth. The species described by Reuss under the name *Lepralia Ungerii* seems to be a connecting form between *C. figularis* and *C. radiata*. It is from the Austro-Hungarian Miocene deposits. *L. Haueri* from the same is most closely allied to the present species, but has a sinus on the lower margin.

CRIBRILINA GATTYÆ, Busk.

Plate XXV. fig. 10.

- LEPRALIA GATTYÆ, *Busk*, B.M. Cat. ii. 73, pl. lxxxiii. fig. 6: *Landsborough*,
 Pop. Hist. B. Z. 326, pl. xviii. fig. 71.
 LEPRALIA STEINDACHNERI, *Heller*, *Bryoz. d. Adriat. Meer*, 33, pl. ii. fig. 5.

Zoæcia ovate, distinct, divided by deep sutures, produced and pointed below, very minute, quincuncial; in the centre a raised subcircular area, umbonate, with radiating lines, scalloped round the margin, a circle of punctures within the edge of the area, and another surrounding the umbo; rest of the cell smooth and glassy, sometimes with radiating striæ; *orifice* semicircular, inferior margin straight, immediately under it three minute punctures, of which the central one is the largest; a *vibraculum* on each side a little below it; marginal spines five, black or brown at the base. *Avicularia* none. *Oæcia* globose, smooth and shining, minutely punctured; two spines showing in front of it.

Colonies originating in a small oval or subcircular cell, with membranous covering and about ten marginal spines, and forming small, silvery-white patches.

Var. *a*. *Zoæcia* covered with radiating ridges; a screen-like elevation placed transversely a little below the inferior margin. *Oæcia* ridged. The spines in this beautiful variety are dark-coloured both at the top and at the base.

HABITAT. On *Phyllophora rubens* and other Algæ, and on shells, from moderately deep water.

LOCALITIES. Sidmouth (Mrs. Gatty): Jersey, on weed (Alder): Guernsey, on shell dredged off Fermain Bay (T. H.): Hastings, normal, and var. *a* (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Adriatic (Heller).

This is the smallest of its tribe; and its minute size and delicate whiteness are characters that at once attract the eye. It has a special liking for *Phyllophora rubens*, the

bright smooth fronds of which are sometimes dotted over with its compact little pearly patches, in company with the ubiquitous *Microporella ciliata*. In deeper water it is found on shells.

There is a graphic description of this species by its accomplished discoverer, the late Mrs. Gatty, in Dr. Landsborough's 'Popular History of British Zoophytes.'

Genus MEMBRANIPORELLA (part.), Smitt.

Der. Dim. of *Membranipora*, a genus of Polyzoa.

BERENICEA (part.), Fleming.

LEPRALIA (part.), Johnston and Gray: Busk: &c.

MEMBRANIPORA (part.), Smitt.

MEMBRANIPORELLA (part.), Smitt, Floridan Bryoz. pt. ii. 10.

GENERIC CHARACTER.—ZOARIUM *incrusting, or rising into free, foliaceous expansions, with a single layer of cells. ZOÆCIA closed in front by a number of flattened calcareous ribs more or less consolidated.*

THIS genus has been constituted for a group of forms (well represented by *Lepralia nitida* of authors) which may be regarded as intermediate between *Membranipora* and the *Lepralia* of Johnston. The passage of the one type into the other may be clearly traced in the history of the species just named. In its earlier condition *Membraniporella nitida* closely resembles one of the spiniferous *Membraniporæ*. The front is completely closed by a membranous roof; and the ribs of the adult state are represented by suberect spines set round the margin. As growth proceeds the spines bend inwards and increase in size, and gradually take on the flattened, rib-like appearance. After a time the opposite rows meet in the centre of the cell-area, and the extremities, which are often enlarged, are soldered together, so as to form a well-marked median line. In some instances the ribs also unite laterally

to a great extent, and the front becomes almost a solid wall. In others they continue quite separate. The pair of ribs immediately below the aperture is often much thickened, so as to form a distinct margin. A similar course of development is met with in some of those forms in which the front wall of the cell is much more thoroughly consolidated. Under *Cribrilina annulata* I have described an analogous mode of growth. In this case, the porous radiating furrows on the surface of the cell are the equivalents of the spaces between the ribs in such forms as *M. nitida*.

As representing a marked developmental stage, the present group appears well entitled to generic rank.

Membraniporella is strictly a transitional form; but as its spines, in the adult condition, are so modified as to form a front wall which rises above the margin and roofs in the area, its place would seem to be amongst the *Cribrilinidæ*. It will include, besides our British species, *Lepralia sceltos*, Busk, from Madeira, and *Flustra Aragoi*, Audouin.

MEMBRANIPORELLA NITIDA, Johnston.

Plate XXVII. figs. 1-8.

ESCHAROIDES NITIDA, *Milne-Edw.* in Lamk. An. s. Vert. (ed. 2), ii. 259.

BERENICEA NITIDA, *Flem. Br. An.* 533.

LEPRALIA NITIDA, *Johnst. Br. Zooph.* ed. 2, 319, pl. lv. fig. 11: *Couch*, Corn. Faun. iii. 114, pl. xxii. fig. 3: *Busk*, B.M. Cat. ii. 76, pl. lxxvi. fig. 1: *Hincks*, Dev. Cat. 43 (sep.); Ann. N. H. ser. 3, ix. 203: *Smitt*, Cefvers. Vet. Akad. Förh. 1865, 32, pl. vi. fig. 1.

MEMBRANIPORA NITIDA, *Smitt*, Krit. Fört., Cefv. &c., 1867, no. 5, 366 and 401, pl. xx. figs. 50, 51.

MEMBRANIPORELLA NITIDA, *Smitt*, Flor. Bryoz. pt. ii. 10.

Zoæcia ovate, arched in front, disposed in lines, silvery and lustrous; front wall composed of a variable number of flattened ribs separated by larger or smaller inter-

spaces, on each side (three to eleven or twelve, or even more); mouth semicircular, frequently a mucronate process, immediately below it, at the top of the median line; oral spines 4-6: a raised *avicularium* at the base of many of the cells, or sometimes two; mandible acute, directed obliquely downwards. *Oæcia* subglobose, smooth or minutely granular, often of a pearly-white colour; an *avicularium* above it on each side, pointing upwards and outwards.

Primary zoæcium broad, ovate; area closed in by a membrane; four tall erect spines at the top, and ten round the margin, slender, and bent inwards (Plate XXVII. fig. 6).

Polypides very delicate, bluish-white, with 14-16 tentacles. Colonies forming subcircular, shining patches.

RANGE OF VARIATION. The proportions of the cell and the number of the rib-like processes composing the front wall are liable to much variation. An elongated oval form from Devonshire has sometimes as many as twelve or thirteen of the latter on each side, placed closely together. This is the maximum; and in the same colony the number ranges from seven to thirteen on each side. Varieties, however, occur in which it is reduced to four or even three; and in these cases the ribs are much broader and more widely separated than in the ordinary form.

In the Devonshire specimens* just referred to the cell is unusually long, and very regular and graceful in shape; the surface is also remarkably bright and silvery. In some cases a broader and flatter type is met with; and in others, again, the cell is contracted above and expanded and well rounded off below. There are also differences in the degree in which the ribs are united and consolidated, and in the breadth of the central band or sternum.

* Dr. Landsborough speaks of very beautiful specimens which he had obtained from Budleigh Salterton, "the whole fabric of which had a metallic appearance; the tiny ribs seemed made of steel."—*Pop. Hist.* p. 319.

The oral spines are generally four in number; but five or six occur; the foremost pair are often very tall and stout. When old the zoarium loses its metallic sheen, becomes of a dull white colour, and assumes a very skeleton-like appearance.

HABITAT. On stones, shells, sponges, Algæ, Ascidians, &c., between tide-marks and in shallow water chiefly; more rarely in deep water.

LOCALITIES. South Devon, common, on stones, sponge, &c., between tide-marks; on *Eschara foliacea*, from moderate depths (T. H.): Tenby (F. Walker): Cornwall (C. W. P.): Guernsey (Dr. M'Intosh): Isle of Man (E. Forbes): Ayrshire (Landsb.): the Minch; Shetland, tide-marks and shallow water (A. M. N.): Berwick (Dr. Johnston): St. Andrews, abundant between tide-marks and in deep water (Dr. M'Intosh): Scarborough (Bean): Wick and Peterhead, tide-marks and deep water (C. W. P.): entrance of Strangford Lough, deep water; Belfast Bay (W. T.).

GEOGRAPHICAL DISTRIBUTION. Roscoff, very common on stones and on *Ascidia sanguinolenta*, from shallow to deep water (Joliet): Douarnenez, Finisterre (Fischer): Bohuslän, Algæ and Ascidians, in shallow water, 7-10 fathoms (Smitt)*: New Zealand (F. W. Hutton).

MEMBRANIPORELLA MELOLONTHA, Busk.

Plate XXVII. figs. 9, 10.

LEPRALIA MELOLONTHA, Busk, B.M. Cat. ii. 78, pl. lxxxv. fig. 3: *Landsb.* Pop. Hist. B. Z. 319, pl. xviii. fig. 70.

LEPRALIA NITIDA, var., "branched in a fine dendritic manner like *Alecto dilatans*," *Johnst.* Br. Zooph. ed. 2, 319.

* Not found as yet in Finmark or Spitzbergen (*Smitt*).

Zoæcia ovate, produced below, distant, separated by a deep and wide groove, disposed in linear series; the central portion of the front wall composed of about eight flat ribs, closely contiguous, on each side, forming an oval figure, which is surrounded by a border of smooth cell-wall; mouth semicircular, a stout tubular process on each side, projecting like a tusk, and two slender spines above (often wanting); at the lower end of the cell, immediately under the ribbed portion, a conical process, inclined upwards. *Avicularia* none. *Oæcia* unknown.

Primary cell small, suborbicular, raised; surface smooth, solid; area occupying the whole upper part of the cell, with membranous covering; no spines. Two normal cells originate from the primary zoæcium; and as growth proceeds the successive series widen, so as to produce a somewhat fan-shaped figure.

Colonies spreading in dendritic fashion, with a tendency to rise into delicate free expansions.

RANGE OF VARIATION. There is very little variability in this species as compared with the last. The number of ribs is pretty constant (six to eight). When young and fresh, the cells are hyaline and glistening; they become dense and opaque with age.

HABITAT. On shells, especially on the oyster, at the mouths of rivers.

LOCALITIES. Estuary of the Thames (Lieut. Thomas): near the mouth of the Orwell, coast of Suffolk (Busk): East coast (Mrs. Gatty): Roach River (Mr. Jeffreys)*.

* If Mrs. Gatty was right in identifying Dr. Johnston's dendritic variety of *Lepralia nitida* with the present species (and it is probable that she was), Kirkwall Bay must be added to the list of localities, on the authority of Lieut. Thomas.

Family XI.—Microporellidæ.

CELLEPORIDÆ (part.), Johnston.

MEMBRANIPORIDÆ (part.), Busk.

PORINIDÆ (part.), D'Orbigny.

ESCHARIPORIDÆ (part.), Smitt.

ZOÆCIA *adnate and incrusting, or forming erect and foliated or dendroid zoaria; orifice more or less semicircular, with the lower margin entire; a semilunate or circular pore on the front wall.*

THE *Porinidæ* of D'Orbigny include two types of form, which seem to be properly referable to separate groups. One is well represented by *Lepralia ciliata* auctt., and the other by *Porina borealis*, Busk (= *Quadricellaria gracilis*, Sars). I have retained D'Orbigny's name for the latter.

Genus MICROPORELLA, Hincks.

Der. From μικρός, small, and πόρος.

ESCHARA (part.), Pallas.

CELLEPORA (part.), Linn.: Audouin.

FLUSTRA (part.), Audouin.

BERENICEA (part.), Fleming.

LEPRALIA (part.), Johnston, &c.

ESCHARINA (part.), M. Edwards: Gray.

HERENTIA (sp.), Gray.

REPTOPORINA (part.), D'Orbigny, Pal. Franç. Terres Crét. v. 441.

PORINA, Smitt, Kritisk Förteckn.

PORELLINA, Smitt (*not* D'Orbigny), Floridan Bryoz.

MICROPORELLA, Hincks, Ann. N. H. for Dec. 1877, 526.

ZOARIUM incrusting. ZOÆCIA with a semicircular aperture, the lower margin entire, and a semilunate or circular pore below it.

WE do not know the physiological import of the defi-

nately shaped opening in the front wall of the cell, which belongs to this genus. But the character, which is constant, may fairly be accounted of considerable importance, and, taken in combination with the form of the aperture, is a good diagnostic mark.

Milne-Edwards has suggested that the pores may be connected with the function of respiration. In his account of *Eschara gracilis*, Lamk.* (a species probably referable to the next family), he expresses his belief that the surrounding water may find access through these openings to the perivisceral cavity, and so promote the oxygenization of the fluids. Whatever may be thought of this view, it is in the highest degree probable that these structures bear some not unimportant relation to the vital economy, and are fairly entitled to consideration in a natural system. In the large and very beautiful pore of *M. Malusii* (woodcut, fig. 8) the aperture is guarded by numerous delicate teeth, which are set round its inner edge; through these the water in all probability finds its way to the interior of the cell. In this case the dentate opening must act as a sieve or strainer, and prevent the entrance of bodies that, from their size or otherwise, might be a source of injury or inconvenience to the polypide.

Fig. 8.



Median pore.

D'Orbigny's *Reptoporida* includes the present group; but it also embraces a somewhat miscellaneous assemblage of forms; and I have therefore thought it better (though most desirous to avoid additions to the nomenclature) to designate it by a new name. *Lepralia bicristata*, Busk (Cape Horn), and *L. Californica*, id., belong to this genus. The latter has an avicularium on each

* 'Recherches anatomiques, physiologiques et zoologiques sur les Polypes' (1838): "Sur les Eschares," p. 30.

side of the cell, but in general character makes a near approach to *M. ciliata*.

The common but very beautiful Australian species, *Lepralia diadema*, MacGillivray, is also a member of the present genus.

a. *With a semilunate pore.*

MICROPORELLA CILIATA, Pallas.

Plate XXVIII. figs. 1-8.

ESCHARA CILIATA, var. β , *Pall.* Elench. 38.

CELLEPORA CILIATA, *Linn.* Syst. ed. 12, 1286.

ESCHARA VULGARIS, var. β , *Moll.* Seerinde, 62, pl. iii. f. 11.

?BERENICEA UTRICULATA, *Flem.* Br. An. 533.

LEPRALIA CILIATA, *Johnst.* Br. Zooph. ed. 2, 323, pl. lvii. figs. 4, 5: *Busk*, B.M. Cat. ii. 73, pl. lxxiv. figs. 1, 2, and pl. lxxvii. figs. 3, 4, 5; *Crag* Pol. 42, pl. vii. fig. 6.

LEPRALIA INSIGNIS, *Hass.* Ann. N. H. vii. 368, pl. ix. fig. 5.

FLUSTRA GENISII, *Aud.* Expl. 239: *Savigny*, Egypte, pl. ix. fig. 5.

ESCHARINA VULGARIS (part.), *Milne-Edw.*, Lamk. An. s. Vert. (ed. 2), 231.

REPTOPORELLINA SUBVULGARIS, *D'Orb.* Pal. Franç. Terr. Crét. v. 477.

LEPRALIA PERSONATA, *Busk*, B.M. Cat. ii. 74, pl. xc. figs. 2, 3, 4.

LEPRALIA LUNATA, *Macgillivray*, Trans. Phil. Inst. Victoria, iv. (1860), 159, pl. ii. fig. 6.

CELLEPORA CRENILABRIS, *Reuss*, Foss. Polypar. Wien. Tertiärb. 88, pl. x. fig. 22.

CELLEPORA PLEUROFORA, *Reuss*, ibid. 86, pl. x. fig. 21.

PORINA CILIATA, *Smitt*, Cefv. K. Vet. Akad. Förh. 1867, Bihang 6 and 58, pl. xxiv. fig. 18.

PORELLINA CILIATA, *id.* Floridan Bryoz. pt. ii. 26, pl. vi. figs. 126-129.

LEPRALIA UTRICULUS, *Manzoni*, Bryoz. Pliocen. Italian., Sitz. k. Akad. d. Wissensch. Bd. lix. 1. Abth. Jän.-Heft, 1869, 7, pl. ii. fig. 12*.

?LEPRALIA GLABRA, *Reuss* (smooth var.), Foss. Bryoz. österr.-ungarisch. Mioc. 17, pl. iv. fig. 3.

* Manzoni's fig. 1, plate ii. ('Supplement') is not referable to this species, but probably to the *F. coronata*, Audouin (= *F. umbracula*, *id.*), which may be identical with Heller's *L. appendiculata*, and perhaps even with *Busk's L. marsupiala*, a Madeiran species. All these forms are certainly most closely allied.

Zoæcia ovate, obscurely six-sided, convex, separated by well-marked sutures, silvery, and more or less distinctly punctate, or white and granular, quincuncial, or disposed in radiating lines; orifice arched above, with a slight rim, the lower margin straight, the upper with from five to seven long spines; median pore lunate, a little below the orifice, frequently borne on a prominent mucro, or sometimes almost hidden behind it; on one side or the other a large *avicularium*, with acute mandible, directed obliquely upwards, which is often prolonged into a slender vibraculoid spine. *Oæcia* globose, occasionally areolated round the base, minutely punctate or granular; two spines visible in front of it.

Var. *personata*. *Oæcium* extended in front, so as to form a wall-like inclosure round the orifice (hooded).

The colonies originate in a small oval cell, with an aperture occupying the entire front, which is covered in by a membrane, and surrounded by numerous slender spines.

RANGE OF VARIATION. This species shows a tendency to variability in almost all portions of its structure, except the orifice of the cell, but may always be easily recognized by the semicircular mouth, the median pore, and the lateral *avicularium*. The texture and sculpture vary with habitat and age. The delicate form, with sheeny frosted surface, occurs principally on weed, between tide-marks, or in shallow water. In deep-water specimens the cells are usually granulous, of denser substance, and a dull white colour. When old, they are less convex, much thickened, and coarse in appearance.

Shape of cells: this is commonly pretty regularly ovate; but sometimes the figure is broad and six-sided. *Arrangement*: usually in quincunx, rarely in radiating lines. *Size*: extremely variable: specimens occur (Pl. XXVIII. fig. 4) in which they are fully a third smaller than in the ordinary

form. *Spines*: variable in number, and often wanting altogether, especially in deep-water specimens. In a remarkable Australian form they are dark-coloured at the base, as in *Cribrilina Gattyæ*. *Median pore*: sometimes nearer to the lower margin of the orifice, sometimes more remote; often elevated on a mucro or knob; in the hooded variety inclosed by the wall-like extension of the oœcium. *Avicularium* developed indifferently on either side of the cell, and rarely on both sides: mandible in many cases extended into a vibraculoid process. *Oœcium*: simply globose or hooded, areolated or plain; sometimes with a prominent umbo on the front of it.

HABITAT. On the red weeds (the delicate variety), stems of *Laminaria*, shells of limpet in rock-pools, stones and dead shells &c., from between tide-marks to 300 fathoms.

LOCALITIES. Generally distributed round our coasts. Shetland, tide-marks to 90 fms. (A. M. N.): off the Deadman, Cornwall, 60 fms. (T. H.): Beaufort Dyke, 110–145 fms. (Capt. Beechey): Belfast Bay (W. T.): Dublin Bay (A. H. H.). Var. *personata*: Hastings (Miss Jelly): Cornwall; Isle of Man (T. H.): Birterbuy Bay (Norman): &c.

GEOGRAPHICAL DISTRIBUTION. Cosmopolitan. Spitzbergen, 6–30 fms. (Lovén): Greenland (Lütken): Nova Zembla, 15 fms. (Nordenskiöld): Bahusia, in deep water (Smitt): coast of Norway, 300 fms. (Sars): coast of Florida, 7–60 fms., hooded variety as well as the normal form (Pourtales): Roscoff, common, especially on *Chondrus* (Joliet): Naples, common, down to 40 fms. (A. W. Waters): Adriatic (Heller): Algiers (J. Y. J.): East Falkland Islands, 4–10 fms., var. *personata*, Busk (Darwin): Geelong; New Zealand, in *Pectunculus* (T. H.): Zanzibar; Aden; Arabian Sea, on weed, taken up in lat. about 15° N., long. about 65° E. (W. Oates): attached to the Falmouth and Lisbon cable, between N. lat. 47° 58'

and $47^{\circ} 35'$, and in W. long. $7^{\circ} 6'$, from 89–205 fms. (Sir James Anderson) : France, S.W. (Fischer) : California (Miss Jelly) * : &c.

RANGE IN TIME. English Coralline Crag, on shell (S. Wood) : Middle Pliocene beds (A. Bell) : Vienna basin (Reuss) : Italian Pliocene beds (Manzoni) : Sicilian Pliocene, Bruccoli (A. W. Waters) : &c.

This protean species presents itself in many disguises, but is easily recognized amidst them all. Perhaps the characteristic features are most completely veiled in the variety with the hooded ovicell, in which the form of the mouth is not apparent, and the pore is sometimes concealed behind the wall which incloses the aperture in front; but even in this case the lateral avicularium is a good diagnostic. The wall is often incomplete towards the centre (in some colonies it is always so), and a subcircular opening is left, through which the pore may be detected.

Busk's *Lepralia personata*, from the Falkland Islands, is evidently only a form of *M. ciliata*, the equivalent of our hooded variety, although it has the pore *outside* instead of within the wall-like extension of the ovicell.

The diversities in size are very striking. On the same shell, specimens may be met with in which the cells are on a totally different scale, ranging from extreme minuteness to the full normal dimensions.

In a variety, which occurs in Australia as well as in

* In the Californian specimen, which I have seen, all the structural features are very pronounced. The wall of the cell is much calcified and thickly punctured; the pore is of unusual size, and the beautiful sieve-like structure very apparent. The oecium is large and with a prominent umbo in front; while the avicularia, which are much elevated, are developed in a great proportion of the cells on both sides. This may be the *Lepralia Californica* of Busk; but if so, it seems to me that this species must rank as a variety of the present form. In one or two instances I have met with two avicularia on a British specimen.

our own seas, the vibraculoid mandible of the avicularium is exceedingly slender and delicate, and the oœcium umbonate. In the Australian form, the base of the oral spines is black, a peculiarity which I have not noted in British specimens. Another marked variety has the surface thickly covered with well-defined granules, the avicularium very large, a prominent mucro below the mouth, concealing the median pore, and a prettily areolated ovicell. In an Algerian specimen, which incrusts a stem, free expansions are given off, composed of two layers of cells placed back to back, and resembling a foliaceous *Eschara* of authors.

The form from the English Coralline Crag and the Italian Pliocene beds corresponds completely with the recent deep-water variety, distinguished by the thick granular wall of the cells.

But the most interesting variation to which this species is liable, is that which takes place in the avicularium. In some cases, and especially in the thick-walled granular form, this organ exhibits the usual structure; in others, and chiefly in the more delicate varieties, the mandible is lengthened and attenuated, so as to take on a distinctly vibraculoid appearance. No alteration, however, takes place in the fixed, beak-like portion of the structure; and the mandible is therefore incapable of any true vibracular function. The two conditions of the avicularium are sometimes met with in one and the same colony. We have here an indication of the way in which the avicularium may pass by gradual modification into the vibraculum.

The pore beneath the orifice is either dentate or filled in by a fine calcareous network (a beautiful structure), which must effectually guard the entrance to the interior of the cell (woodcut, fig. 9).

Fig. 9.



Pore (Californian var.).

MICROPORELLA MALUSII, Audouin.

Plate XXVIII. figs. 9-11; and Plate XXIX. fig. 12.

- CELLEPORA MALUSII, *Aud.* Expl. i. 239: *Savigny*, Egypte, pl. viii. fig. 8.
 CELLEPORA MACRY, *W. Thompson*, Ann. N. H. x. 20.
 LEPRALIA BIFORIS, *Johnst.* B. Z. ed. 2, 314, pl. lvi. fig. 2.
 HERENTIA BIFORIS, *Gray*, B.M. Rad. 123.
 ESCHARINA CORNUTA, *D'Orb.* Voyage dans l'Amér. mérid. (1839), 13, pl. v.
 figs. 13-16: *id.* (*Reptoporina*), Pal. Franç. T. C. v. 443.
 REPTOPORINA MALUSII, *id.* Pal. Franç. Terr. Crét. v. 443.
 REPTOPORINA HEXAGONA, *id.* *ibid.* 444 (*fide* Fischer).
 LEPRALIA MALUSII, *Busk*, B.M. Cat. ii. 83, pl. ciii. figs. 1-4; Quart. Journ.
 Micr. Sc. viii. 125, pl. xxiv. fig. 1; Crag Pol. 53, pl. viii.
 fig. 3: *Heller*, Bryoz. Adriat. Meer. 34 (*not* pl. ii. fig. 3):
 Manzoni, Suppl. Bryoz. Medit. 5, pl. ii. fig. 2 (Sitzb. k.
 Akad. d. Wissensch. Bd. lxiii. 1ste Abth. Februar-Heft,
 1871) (the stellate pores absent).
 LEPRALIA THYREOPHORA, *Busk*, Quart. Journ. Micr. Sc. v. 172, pl. xv. figs. 4, 5.
 PORINA MALUSII, *Smitt*, l. c. 5 & 56, pl. xxiv. figs. 11, 12.

Zoëcia ovate or rhombic, often truncate at each extremity, convex, well-defined, disposed in radiating lines; surface smooth and silvery, more or less thickly covered with stellate pores, especially round the sides and immediately below the orifice, the central space usually entire: *orifice* arched above, straight below, with three or four spines on the upper margin, the lowest of which on each side is occasionally forked: *median pore* lunate, toothed, placed about halfway down the cell, often surrounded in great part by a raised border. *Oæcia* globular, smooth, or with indistinct radiating lines, sometimes porcellaneous, areolated round the base.

*Primary cell** oval, the aperture occupying a large proportion of the front, with membranous covering and about ten short spines round the margin (woodcut, fig. 10); from this the normal zoëcia radiate in all directions, spreading in somewhat circular patches (woodcut, fig. 11).

* Round the lower part of the cell there are four elongate-oval foramina, of which two are placed at the extremities and one on each side, a little below the top: they correspond with the gemmæ to which the zoëcium gives origin.

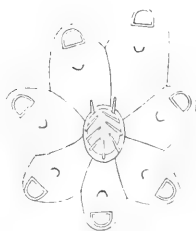
Var. *a* (*thyreophora*). Upper half of the zoœcia in front occupied by a scutiform area, in the centre of which is

Fig. 10.



Primary cell.

Fig. 11.



Centre of colony.

the lunate pore, and on either side a single row of punctures, which also extends across the front of the cell immediately below the mouth. (*Busk.*) (Pl. XLV. fig. 1.)

Var. β (*vitrea*). Zoœcia glassy and transparent, and entirely destitute of the stellate pores. In this variety the cells are unusually small, and the two anterior spines are forked.

RANGE OF VARIATION. This is a much less variable species than the last. The stellate pores are occasionally wanting altogether, and the walls of the cell are smooth and glassy. In some cases they form a single line along the sides, and a small group above the central pore; in others, again, they are more diffused, and the smooth, central space is proportionately reduced. In old specimens the walls are thickened, the surface is reticulated, and the median pore surrounded by an elevated border.

Occasionally the two anterior spines are forked, a character which is constant in some species. According to Busk, in all South-American specimens the cells are much larger than in the European form—a difference which is no doubt due to climatal influences.

Lepralia thyreophora, Busk, is a very unimportant variation upon the normal *M. Malusii*. The inclosed "scutiform area," which is its principal feature, is due to a very slight change in the ordinary constitution of the cell. The raised line which bounds its anterior surface, and which is generally so far down as to be all but invisible, in the New-Zealand form is placed higher up on the front of the cell, where it is distinctly seen, inclosing a smooth area, and edged along its inner margin by a line of the stellate pores. The size of the area, however, varies greatly; and there is a marked tendency to a return to the normal condition. I have noticed that in this variety the cells are much less closely compacted together than in our British form; and to this in great measure, I think, is due the peculiarity just referred to. Apart from these points, the New-Zealand species agrees entirely with our own.

HABITAT. On weed, shells, stones, &c., from inshore to deep water (60 fathoms).

LOCALITIES. Widely distributed and abundant. Guernsey; South Devon; Cornwall, 60 fathoms; Isle of Man (T. H.): Sidmouth, a transparent variety on weed (Mrs. Gatty): Killinchy, co. Down; Roundstone (W. T.): coast of Antrim, deep water (Hyndman): Northumberland, occasionally (Alder): St. Andrews (Dr. M'Intosh): Wick (C. W. P.): Ayrshire (Landsborough): the Minch; Shetland, tide-marks to 50 fathoms (A. M. N.): Birterbuy Bay (G. S. Brady): &c.

GEOGRAPHICAL DISTRIBUTION. Gullmaren, Bahusia, 10-20 fathoms (Smitt): Bergen (A. M. N.): Finmark, rare (Lovén): Greenland (Lütken): Mediterranean (Manzoni): Adriatic (Heller): France, south-west (Fischer): Black Sea (Ulianin): South Patagonia, 48 fathoms; Terra del Fuego; Falkland Islands (Darwin): Valparaiso, on shells of *Venus thaca*, very common (D'Orbigny): New Zealand

(Dr. Lyall). Var. *thyreophora*:—Australia; New Zealand (T. H.): Mediterranean (A. W. Waters).

RANGE IN TIME. Coralline Crag, on *Terebratula* (Bowerbank): Older Pliocene, Castrocaro (Manzoni).

b. *With a circular pore.*

MICROPORELLA IMPRESSA, Audouin.

Plate XXVI. figs. 9–11; and Plate XXIX. figs. 10, 11.

FLUSTRA IMPRESSA, *Aud.* Expl. (1826) i. 240: *Savigny*, Egypte, pl. x. fig. 7.

? ESCHARA BIMUCRONATA, *Moll*, *Eschara* &c. 65, pl. iv. fig. 18 (= var. α).

LEPRALIA GRANIFERA, *Johnst.* Br. Z. ed. 2, 309, pl. liv. fig. 7: *Busk*, B.M.

Cat. ii. 83, pl. lxxvii. fig. 2, pl. xcvi. figs. 6, 7.

LEPRALIA PYRIFORMIS, *Busk*, Crag. Pol. 51, pl. v. fig. 3 (= var. γ).

Zoæcia elongated, often lozenge-shaped, narrowed off to a point below, quincuncial, walls vitreous and glistening, thickly covered with raised punctures, or with a line of them round the margin; *orifice* arched above, straight below, with a narrow rim, unarmed; *median pore* minute, circular, slightly dentate, placed a little below the orifice, sometimes a blunt umbo immediately behind it. *Oæcia* globose, punctured.

Polypides small, with about 15 tentacles.

Var. α (? *bimucronata*, *Moll*: var. *cornuta*, *Busk*). An erect, conical process on each side of the orifice; sometimes an umbo on the upper part of the oæcium in front.

Var. β (*glabra*). *Zoæcia* white and porcellaneous, flattish, transversely rugose, punctures round the margin only, in a single line; rest of the surface smooth; an umbo below the median pore. *Oæcia* with a very prominent keel down the centre, terminating above in a large umbo, with a line of punctures round the base and a few scattered over the surface.

Var. γ (*pyriformis*, *Busk*). *Zoæcia* destitute of the median pore.

RANGE OF VARIATION. The cells vary slightly in form, being sometimes rather irregularly ovate, and at others of a very neat and definite diamond- or lozenge-shape. The punctures are diffused over the surface, or merely ranged in a single line round the edge of the cell. The umbo is occasionally wanting, and at times is of great size and fantastic form. The œcium is either simply globose and punctured, or keeled down the front and umbonate.

HABITAT. On weed, stones, and shells, from tide-marks to deep water (30–40 fathoms). Chiefly a littoral form.

LOCALITIES. South Devon; Ilfracombe, under ledges on the Capstone; off the Deadman, Cornwall; Isle of Man (T. H.): Bamborough, tide-marks (Alder): Holy Island and Berwick (Johnston): St. Andrews, near low-water mark (Dr. McIntosh): Ayrshire (Landsborough): Shetland, tide-marks (Norman): island of Stroma (C. W. P.): Ireland (Mrs. Gatty). Var. *cornuta*:—Lambay Island (W. T.): Salcombe Bay; Guernsey, on red weed (T. H.).

GEOGRAPHICAL DISTRIBUTION. Algiers (J. Y. J.): France, S.W. (Fischer): Roscoff (Joliet): Bergen (A. M. N.). Var. *a*. Naples (Waters).

There can be no doubt of the identity of *L. granifera*, Johnston, with the *Flustra impressa** of Audouin; and the more familiar name must give place to the earlier. The figure in Savigny's work represents our var. β (*glabra*) with great fidelity.

The Crag form, *Lepralia pyriformis*, Busk, agrees exactly with the present in every point but the absence of the median pore; it ought, I think, to rank as a variety. The diffusion of the punctures over the entire surface of the cell is not, as Mr. Busk supposes, uncommon in our *M. impressa*.

This is a very brilliant species—in its young and fresh

* The *Eschara impressa* of Moll is a *Steganoporella*.

condition, the vitreous and hyaline cells literally glittering on the red weed, which it specially loves. "It is so glassy in its texture," writes Mrs. Gatty, "that the colour of the red *Phyllophora* can be distinguished through the cell." The punctures, which are surrounded by a white ring, show very prettily on the clear and glistening surface. When the polypides are living, their delicate bells have the appearance of a bluish mist over the hyaline and speckled crust.

MICROPORELLA VIOLACEA, Johnston.

Plate XXX. figs. 1-4.

LEPRALIA VIOLACEA, *Johnst.* Br. Zooph. ed. 2, 325, pl. lvii. fig. 9: *Busk*, B.M. Cat. ii. 69, pl. lxxxvii. figs. 1, 2; Crag Pol. 43, pl. iv. fig. 3: *Manzoni*, Bryoz. Plioc. Ital., 1st Contrib. 5, pl. i. fig. 9 (Sitzb. k. Akad. d. Wissensch. Bd. lix. 1. Abth. Jän.-Heft, 1869).

ESCHARELLA VIOLACEA, *Gray*, Brit. Rad. 125.

LEPRALIA PLAGIOPORA, *Busk*, Crag Pol. 44, pl. iv. fig. 5.

LEPRALIA DIVERSIPORA, *Reuss*, Foram. Anthozoa u. Bryoz. d. Deutsch. Septar. 60, pl. viii. fig. 3.

PORINA VIOLACEA, *Smitt*, Floridan Bryoz. pt. ii. 30.

PORINA PLAGIOPORA, *id.* *ibid.*

Zoecia ovate or lozenge-shaped, surface roughened, frequently punctured or areolated round the border, and sometimes surrounded by a raised line; a rather deep depression in the centre, within which there is a single circular pore; orifice slightly arched above, elongated transversely, the lower margin nearly straight; peristome somewhat thickened and raised above; immediately below the inferior margin an *avicularium*, with an acute mandible pointing upwards. *Oecia* none.

Var. *a.* *Zoecia* flat below, much raised towards the orifice; the peristome much elevated behind the mouth, and projecting like a pent-house; two pores in the central depression. *Avicularium* very long and slender; raised

tubular pores scattered over the zoarium, generally one or two above the orifice.

Var. β (*plagiopora*). The central avicularium very large, and turned obliquely to one side.

Colonies forming large, rather thick crusts, bright and glossy when fresh, spreading irregularly, and of a dark purplish or cream colour.

Var. α seems to be always of a light colour.

RANGE OF VARIATION. The cells vary slightly in shape, being sometimes ovate or subpyriform, and sometimes hexagonal or lozenge-shaped. They vary more remarkably in size; and within the limits of one and the same colony cells of the most different dimensions are found associated (Plate XXX. fig. 4). They are frequently punctured round the margin, and the punctures are sometimes channelled. In young cells a number of narrow loop-like fissures or areolæ extend from the margin to the middle. These disappear with the progress of the calcification, which materially changes the appearance, and destroys much of the beauty of the species. In some cases the punctures extend over a large portion of the surface. In certain states the walls are much thickened, and covered with large perforations, and present a coarsely reticulate appearance. In old specimens the cells are almost confluent, the zoarium is of a dead white colour, flattish, of granular texture, and sometimes thickly perforated. The avicularium is only represented by a foramen a little below the orifice.

In the curious variety α , the elevation of the cell towards the oral extremity is a very marked peculiarity; the avicularium is much more elongate than in the normal form, with a very slender mandible; the one central pore is replaced by a pair; and a new feature makes its appearance in the raised tubules (? aviculiferous) which are dis-

tributed over the zoarium. In this variety too the surface is either smooth or minutely granulated, like shagreen.

L. plagiopora, Busk, from the Crag, should probably be ranked as a variety of the present species. It differs from it in the size and oblique direction of the avicularium—points which taken by themselves are of very small moment.

Smitt has suggested that if from any cause the avicularium were more fully developed than usual, as not unfrequently happens in other species, it might probably take an oblique direction to obtain sufficient space.

In a beautiful specimen from the Crag (Plate XXX. fig. 4) each cell is bounded by an incised line, within which is a row of numerous small punctures, which are occasionally channelled.

M. violacea is commonly of a dark purplish colour; but cream-coloured specimens not unfrequently occur. Heller remarks that the light-coloured form is pretty common in the Adriatic, but that he had only observed the dark violet variety once.

HABITAT. On shells, stones, Nullipores, &c., generally in moderate depths.

LOCALITIES. Isle of Man (E. Forbes): Cornwall (Peach): Brixham, from the trawlers; Torbay; off the Deadman; Guernsey (T. H.): Birterbuy Bay (G. S. Brady).

Var. *a*. Guernsey, abundant (T. H.): Hastings (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Roscoff, extreme low-water mark (Joliet): Algiers (J. Y. J.): Adriatic, the light-coloured variety pretty common, the dark violet once on Nullipore (Heller): Gibraltar Bay (Landsborough): Mazatlan, on *Murex* and *Byssosarca pacifica*; Adelaide, a much thickened variety (T. H.): west off Tortugas, in 35 fathoms (Pourtales): Charente-Inférieure (Fischer).

Var. β (*plagiopora*). West off Tortugas, in 60 fathoms (Pourtales) : France, S.W. (Fischer).

RANGE IN TIME. Italian Pliocene deposits, very abundant, forming very large colonies of a dark-grey colour (Manzoni) : Tertiary beds at Söilingen (Reuss) : Coralline Crag (S. Wood) : Middle Pliocene (= Coralline Crag and Red Crag, part) (A. Bell).

In the oldest and most worn condition this species may be recognized by the central depression and pore, and the foramen which marks the position of the avicularium.

The Tertiary *L. diversipora* of Reuss is, I think, referable to *M. violacea*, the only point in which it seems to differ from the recent form being the shape of the central pore, which is described as crescentic. In fossil specimens the double pore of the var. *a* might probably be represented by such a figure ; but in any case so slight a difference could hardly of itself be accounted distinctive.

A curious point in the history of *M. violacea* remains to be noticed. Scattered over the colony, usually in small groups, cells of abnormal size are often to be met with, which are furnished with a narrow slit-like mouth, much extended transversely, and filled in by a corneous operculum. These gigantic cells are about twice the size of the ordinary zoëcia. They are ovate in form, and want the central depression ; the pore, however, occupies its usual position ; and the avicularium is present, though reduced in size and separated by a space from the orifice. They are probably cells modified for the discharge of reproductive functions. *M. violacea* is one of the species on which ovicells have not been noticed.

Fig. 12.



Young cell.

Genus DIPORULA, *Hincks*.

Der. From *dis*, double, and *πόρος*, an opening.

ESCHARA, part., auctt.

DIPORULA, *Hincks*, Ann. N. H. Feb. 1879, 156.

GENERIC CHARACTER.—*ZOECIA with the orifice arched and expanded above, contracted below, and slightly constricted by two lateral projections (horseshoe-shaped), lower margin straight; a semilunate pore on the front wall.*
 AVICULARIA.

DISTINGUISHED from *Microporella* by the structure of the orifice, which exhibits much the same type of form as we have in the genus *Lepralia*; and, so far as the British species is concerned, by its dendroid zoarium with cylindrical branches.

DIPORULA VERRUCOSA, *Peach*.

Plate XXXI. figs. 1, 2.

ESCHARA VERRUCOSA, *Peach*, Journ. Roy. Inst. Cornwall, iii. (1868-70), 116; figured in vol. iv. (1871-73), 88.

ESCHARA LUNARIS, *Waters*, 'Bryozoa from the Pliocene of Brucoli (Sicily),' 11, fig. 9.

Zoarium of a light brownish colour, dichotomously branched, the branches cylindrical, rather thick, of about equal size to the extremities. *Zoecia* disposed in about seven longitudinal rows, quincuncial, ovate, slightly convex; the surface smooth in the young cells, and more or less pitted, a row of large punctures round the margin; in the older portions of the zoarium the walls are much thickened, rugose, and covered with wart-like prominences, and the boundaries of the cells are obliterated; orifice somewhat raised, longer than broad, arched above, slightly constricted below the middle, the sides inclined inward, lower margin straight; the

peristome thickened, especially round the upper part, and bearing usually five spines, of which the lowest on each side is larger than the rest; a minute pore a little below the inferior margin, and on one side a raised *avicularium*, with a produced vibraculoid mandible directed outwards. *Oacia* globose, finely punctured.

LOCALITY. Lantivet Bay, Cornwall (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Naples, 40 fms. (Waters).

RANGE IN TIME. Sicilian Pliocene (Waters).

Nothing is known of the size which this species attains, or of its mode of growth; but the fragment obtained by Mr. Peach shows it to be of a stout habit.

The characters of the cells can best be recognized in those which are placed at the tips of the branches. There they are distinct, though only moderately convex, broadly ovate, almost smooth, and bordered by a row of rather large foramina. The surface is also usually more or less covered with smaller punctures or "pit-like depressions." The pore is placed centrally at a very short distance below the inferior margin. The avicularium is developed indifferently on either side; it occupies the inner aspect of a large conical elevation, which rises a little below the aperture. The mandible is triangular below, and runs out above into a long spinous process, similar to that which occurs on *Microporella ciliata*.

There is a little variation in the shape of the orifice; the sides are sometimes rather straighter than is usual, and the constriction below is not quite so strongly marked. In such cases there is less disproportion between the breadth above and below. In the typical form the orifice expands above, and is decidedly contracted by two lateral projections a little above the lower margin, where the width is only about half as great as at the top.

A remarkable change is produced in the appearance of the zoarium by the progress of the calcification. At a very short distance from the top of the branches the boundaries of the cells and many of their characteristic features are sometimes obliterated by the enormous overgrowth of calcareous matter; the whole surface, with the exception of a small space below the orifice, is overlaid with a thick crust, which rises into numerous wart-like prominences, and is traversed by irregular grooves, and presents, even to the naked eye, a strikingly rugose appearance. In the older portions little but the orifice is visible of the original cell; even the avicularium is almost buried beneath the stony envelope. In this condition the species well deserves the name which Mr. Peach has given it.

Genus CHORIZOPORA.

Der. From χωρίζω, to separate, and πόρος, a passage or opening.

FLUSTRA (sp.), Audouin.

LEPRALIA (sp.), Johnston: Busk: &c.

MOLLIA (part.), D'Orbigny.

GENERIC CHARACTER.—ZOÆCIA *more or less distant, connected by a tubular network; the orifice semicircular, with the inferior margin entire; the special pore wanting.*

THIS genus agrees with *Microporella* in having a semicircular orifice with the lower lip straight and entire, but differs from it and the rest of the family in being destitute of the special pore on the front wall. In other respects it is peculiar. The cells are separated from one another, but are connected at intervals by tubular extensions of the wall (Plate XXXII. fig. 4). In our British form the tubes sometimes pass imme-

diately from cell to cell; and the zoëcia have then the appearance of being surrounded by a single line of punctures; in other cases a number of tubercles are interposed between the cells, which are connected with one another and with the neighbouring zoëcia by tubular bands; and in this way a reticulated crust is formed, which is often of considerable extent. The tubercles, which are really modified cells, are sometimes merely perforated at the top; but they frequently bear avicularia: one of them is always placed (in *C. Brongniartii*) at the upper extremity of the zoëcium, or on the summit of the ovicell, when present.

The only species, I believe, which is referable to this genus is the *Flustra Brongniartii* of Audouin. Its affinities are somewhat obscure; but the simple semi-circular orifice allies it to the present family, while the absence of the special pore and the peculiar condition of the zoarium seem to entitle it to a separate place.

The mode in which the cells are developed in *C. Brongniartii*, though by no means unique, differs from that which is prevalent in this section of the Polyzoa. In the incrusting forms, massed together under the old genus *Lepralia*, we usually find that the nascent cells on the edge of the colony are sketched out to begin with; they are outlined in full; the foundations of the whole structure are first laid, and on these the walls are gradually built up. But in *C. Brongniartii* (and some other forms) the cell grows upwards from the base, each section of it is completed at once; there is no ground-plan of the whole. Increase takes place along the free upper extremity; and the successive increments are marked by transverse striæ on the surface.

The same mode of growth occurs in *Schizoporella hyalina*.

CHORIZOPORA BRONGNIARTII, Audouin.

Plate XXXII. figs. 1-4.

FLUSTRA BRONGNIARTII, *Audouin*, Expl. i. 240: *Savigny*, Égypte, Pol. pl. x. fig. 6.

LEPRALIA TENUIS, *Hassall*, Ann. N. H. ix. (1842), 412: *Johnst.* B. Z. ed. 2, 303, pl. liv. fig. 2.

LEPRALIA ASSIMILIS, *Johnst.* B. Z. ed. 2, 304.

LEPRALIA JACOTINI, *Gray*, B.M. Rad. 117.

LEPRALIA BRONGNIARTII, *Busk*, B.M. Cat. ii. 65, pl. lxxxi. figs. 1-5; *Crag* Pol. 46, pl. vi. fig. 1: *Heller*, Bryoz. d. Adriat. Meer. 25: *Manzoni*, Bryoz. foss. Ital. 2nd Contr. 7, pl. ii. fig. 9 (*Sitzb. k. Akad. d. Wissensch. Bd. lix. 1. Abth. April-Heft, 1869*).

MOLLIA TUBERCULATA, *D'Orb.* Pal. Franç. Terr. Crét. v. 388.

MOLLIA BRONGNIARTII, *id.* l. c.

? REPTESCHARINELLA RHOMBOIDALIS, *id.* l. c. 429.

LEPRALIA CAPITATA, *Reuss*, Bryoz. d. österr.-ungar. Miocäns, 21, pl. iv. fig. 7.

Zoæcia ovate-elongate, somewhat pyriform, distinct, separated by reticulated spaces or by a single row of interstitial punctures; surface smooth and silvery, or transversely furrowed; orifice semicircular, with a thin, very slightly raised peristome, frequently a prominent mucro a little below it; at the top of each cell a small *avicularium* with pointed mandible, directed upwards. *Oæcia* prominent, smooth, subpyramidal, often with a keel in front; a small *avicularium* on the summit. Colonies forming large, often silvery crusts, with a lobed margin; frequently assuming a very definite figure.

RANGE OF VARIATION. The degree in which the reticulated crust between the cells is developed varies greatly; and the general appearance of the species is affected accordingly. In many cases the cells seem to lie close together; but the connecting tubes may be detected towards the margin of the colony. Sometimes they are bordered by a single line of punctures; sometimes a rather wide interspace separates them, filled in by a tubular network and a number of tubercles frequently bearing *avicularia*. The

cells are usually elongate and pointed below ; but a shorter form occurs, which is rounded off at the base. The texture of the cell-wall is generally very delicate and translucent, and the surface smooth and shining. In one variety, however, the cells are strongly furrowed transversely ; they are also frequently traversed by delicate longitudinal striæ. The mucro (which is sometimes wanting altogether) is often placed immediately below the inferior margin, rising above it, and projecting over the mouth. When thus placed it is expanded at the base, and tapers off to a sharp point above. It also occurs lower down on the cell-wall, and is not unfrequently central. The keel on the front of the ovicell is often wanting.

HABITAT. On shells, stones, *Fucus*, &c., from shallow to deep water.

LOCALITIES. South Devon, very abundant ; Ilfracombe, on *Laminaria* ; off the Deadman, 60 fathoms ; Isle of Man (T. H.) : Tenby (F. Walker) : Hastings (Miss Jelly) : Northumberland, rare ; on a stone from deep water, Cullercoats (Alder) : St. Andrews, on *Laminaria*-roots thrown ashore after storms, rather plentiful (Dr. M'Intosh) : Ayrshire (Landsborough) : off Sana Island (Hyndman) : Shetland, 40-100 fathoms, frequent (A. M. N.) : Dublin Bay (Hassall) : Birterbuy Bay (G. S. Brady) : &c.

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Busk) : Algiers (J. Y. J.) : Adriatic, on shells, not rare (Heller) : on the Falmouth-Lisbon cable, between N. lat. $47^{\circ} 58'$ and $47^{\circ} 35'$ and in W. long. $7^{\circ} 6'$, from 89-205 fathoms (Sir J. Anderson) : Roscoff (Joliet) : France, S.W. (Fischer).

RANGE IN TIME. Coralline Crag (Searles Wood) : Pliocene deposits at Volterra and Castrocaro (Manzoni) : Austro-Hungarian Miocene (Reuss).

Family XII.—*Porinidæ* (part.), *D'Orbigny*.*MEMBRANIPORIDÆ* (part.), Busk.*ESCHARIPORIDÆ* (part.), Smitt.

ZOARIUM *incrusting, or erect and ramified. ZOÆCIA with a raised tubular or subtubular orifice, and frequently a special pore on the front wall.*

It is difficult to determine how far division and subdivision should be carried in classification. The present family has many points of affinity with the preceding; and it may fairly be a question whether it is better to separate the two on the ground of their differences, or to blend them for the sake of their agreement.

On the whole (though not without doubt) I am inclined to keep them apart, taking the tubular prolongation of the cell above, with its terminal and usually orbicular orifice, as the chief characteristic of the present group; in the more typical forms we have also the special pore on the front wall*. Amongst the *Microporellidæ* the mouth of the cell is either semicircular or exhibits a modification of this form, the lower margin being always straight or nearly so. It is never elevated on a free tubular extension of the cell-wall. In the present family there is a certain indefiniteness in the degree in which the oral extremity of the zoëcia is developed; but the adult cell is always more or less lageniform.

The special pores amongst the *Porinidæ* seem to be of simple structure, and destitute of the protective contrivances which occur so commonly in those of the preceding family.

* In the aberrant genus *Lagenipora* it is wanting; but the zoëcia are so essentially Porinidan that it naturally finds a place in this family.

The genus *Tubucellaria*, D'Orbigny, must rank in the present group, with which it agrees entirely in the character of the zoëcium, though distinguished from the other members by its articulated zoarium.

Genus PORINA, *D'Orbigny*.

Der. From *πόρος*, an opening.

- ESCHARA (part.), auctt.
- BIDIASTOPORA (part.), D'Orbigny.
- PUSTULIPORA (part.), M. Sars.
- LEPRALIA (part.), Busk.
- PORINA, D'Orbigny, Pal. Franç. 1851 (*not* Smitt).
- ONCHOPORA (part.), Busk.
- QUADRICELLARIA, Sars (*not* D'Orbigny).
- ANARTHROPORA (part.), Smitt.
- TESSARADOMA (sp.), Norman.
- CYLINDROPORELLA (sp.), Hincks.

GENERIC CHARACTER.—ZOECIA *tubular or subtubular above, with a terminal circular orifice; a median pore on the front wall.* ZOARIUM (*in the British species*) *incrusting, or erect and ramose.*

As employed by D'Orbigny, the name *Porina* is restricted to species with erect and branched zoaria, such as our *P. borealis*; but if the difference in habit between it and *P. tubulosa* is not regarded as generic, we may very properly give it a wider application, and make it cover the larger group. This is the more allowable, as there is no other available name which would be appropriate under the circumstances.

Porina borealis was originally described by Sars as a *Pustulipora*. Subsequently (1863) he transferred it to the Cheilostomata, to which it properly belongs, and founded for its reception a new genus, *Quadricellaria*.

This name, however, had been previously (1850) appropriated by D'Orbigny, and could not stand. In the meanwhile Busk, having only a fragment to deal with, had made it an *Onchopora*. It then found a home in the *Anarthropora* of Smitt, from which, however, it was subsequently dislodged by Norman as an alien, and he proposed for it the genus *Tessaradoma*. I most reluctantly disturb it once more; but, as I can find no essential distinction between the *Tessaradoma* of Norman and the *Porina* of D'Orbigny, founded as early as 1851, I have no choice but to refer it to the latter. Now that incrusting species are admitted to the genus, Norman's name would, in any case, be clearly inapplicable.

The British form, indeed, has fewer rows of cells than the species described in the 'Paléontologie;' but their mere number is a matter of no systematic importance; the difference between four and six or eight cannot reasonably be made one of the criteria of a genus. The point has no structural significance. In all essential particulars *Tessaradoma* and *Porina* are identical.

Unfortunately the change in the generic designation involves the displacement of Sars's specific name for the British form, as the *Eschara gracilis*, Lamk., is a *Porina*. It becomes necessary, therefore, to adopt in its stead Busk's name *borealis*, though it seems hardly right that the discoverer of the species and the first to describe it should have no direct part in it. I should gladly connect his name with it did the laws of scientific nomenclature permit.

As to the union of *P. tubulosa* and *P. borealis* in one genus, the cells of the two agree in all essential points; and, as I have already urged, there seems to be no sufficient reason for creating genera merely to represent such differences of habit as they exhibit.

a. *Zoarium erect, ramose.*

PORINA BOREALIS, Busk.

Plate XXXI. figs. 4-6.

PUSTULIPORA GRACILIS, *Sars*, Reise i Lofot. og Finn. (1850), 26.

ONCHOPORA BOREALIS, *Busk*, Quart. Journ. Micr. Sc. viii. (1860), 213, pl. xxviii. figs. 6, 7.

QUADRICELLARIA GRACILIS, *Sars*, Beskr. Norske Polyz. (1863), 15 : *Alder*, Quart. Journ. Micr. Sc. (n. s.) iv. (1864), 101, pl. ii. figs. 9-12.

ANARTHROPORA BOREALIS, *Smitt*, Cefvers. K. Vet.-Ak. Förh. 1867, Bihang, 8 and 67, pl. xxiv. figs. 25-29.

TESSARADOMA GRACILE, *Norman*, Shetland Polyz., Rep. B. A. 1868, 309.

TESSARADOMA BOREALE, *Smitt*, Flor. Bryoz. pt. ii. 32, pl. vi. figs. 1, 3, 4, 5.

Zoarium white, slender, much branched dichotomously ; branches cylindrical, tapering somewhat towards the extremity. *Zoæcia* disposed in four longitudinal series, ovate, slightly convex, separated by indistinct lines, with a row of channelled pores round the margin, and traversed longitudinally by delicate undulating furrows ; orifice orbicular, sometimes bilabiate, subtubular ; median pore placed some way (usually about one third the length of the cell) below the aperture. *Avicularia* small, circular, somewhat raised, usually one on each side, a little below the aperture, and occasionally others in the line of the punctures. *Oæcia* terminal, slightly raised, transversely elliptical, with a striated surface.

Polypide with 18-20 tentacles.

Height of specimens about 1 inch, occasionally nearly 2 inches.

HABITAT. On stems of *Tubularia indivisa* and *Sertulariæ*, &c., from deep water.

LOCALITY. Shetland (*Barlee*) ; *ibid.*, rather local, but not rare on the Outer Haaf (A. M. N.)

GEOGRAPHICAL DISTRIBUTION. Near Bergen, 30-40 fathoms, on rocky ground ; Christiansund ; Bejan, mouth of the Trondhjems fjord ; Lofoten ; Finmark (M. Sars) :

Bahusia, at great depths, rare (Lovén) : between Norway and Spitzbergen, $77^{\circ} 5'$ N. lat., $10^{\circ} 5'$ E. long., in 600 fathoms, muddy ground (Dr. Chydenius, Swed. Exped.) : Bohuslän, 120–130 fathoms (Olsson) : Florida, 82–450 fathoms, abundant ; off Portugal ; Azores (Smitt).

This species varies in the habit of growth, the branches being in some cases (as Sars has remarked) erect and compact, whilst in others they spread out horizontally and on all sides. The cells are ranged in four longitudinal rows, alternating regularly with each other, so that the opposite cells are on the same level. The avicularia are somewhat irregular both in number and position ; besides those which have been mentioned, there is occasionally one of larger size and much raised on the front wall. Except in the younger portions of the colony, the zoæcia are not usually well defined ; as calcification proceeds, their boundaries are almost obliterated, and the zoarium presents a uniform surface, traversed continuously by the undulating furrows, which wind round and inclose the pores and avicularia.

b. *Zoarium incrusting.*

PORINA TUBULOSA, Norman.

Plate XXXII. figs. 6–9.

LEPRALIA TUBULOSA, *Norman*, Shetland Pol., Rep. B. A. 1868, 308 : *Hincks*, on Arctic Polyzoa, Ann. N. H. January 1877, 101, pl. xi. fig. 8 (see also Ann. N. H. July 1877).

ANARTHROPORA MONODON, forma MINUSCULA, *Smitt*, Öfv. af K. Vet.-Akad. Förh. 1867, Bihang, Krit. Förteckn. iv. 7 & 65, pl. xxiv. figs. 20–22.

CYLINDROPORELLA TUBULOSA, *Hincks*, Ann. N. H. Dec. 1877, 528.

Zoæcia separated by very shallow sutures and disposed in regular linear series, ovate and somewhat depressed

below, smooth, punctured with small stellate pores; above, produced into a long, tubular neck, which stands erect, surface entire, with a circular orifice and thin peristome, which is armed in the young state with two or four spines; on the lower part of the neck a large projecting tubular pore. *Oæcia* arcuate, shallow, set very far back behind the tubular peristome, smooth, with a few perforations.

RANGE OF VARIATION. The cylindrical prolongation of the cell varies considerably in length. This is partly dependent upon age; and in marginal cells the erect portion and the pore, which is placed upon it, are wanting altogether. Apart from this, however, colonies differ very much in the degree in which the neck is developed. In specimens from Greenland and the Gulf of St. Lawrence it is a much less striking feature than in British examples.

HABITAT. On stones, shells, Algæ, &c., from the littoral region to deep water.

LOCALITIES. Shetland; "on a stone dredged in a few fathoms water at Hillswick" (A. M. N.): Wick, between tide-marks (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Spitzbergen, not common, on Algæ, Ascidians, shells, from the littoral region to 30–50 fathoms (Smitt): off Frederickshaab, Davis Straits, 100 fathoms (Wallich): off Bear Island (Dutch Arctic Exped.): Gulf of St. Lawrence (Dr. Dawson).

RANGE IN TIME. Scotch Glacial deposits (Geikie): Palæolithic (A. Bell).

In this well-marked form the oral spines are commonly wanting, and are only to be met with on the edge of the colony. The ovicell is placed very far back; and the cylindrical portion of the cell rises in front of it. The pore is situated at the base of the neck, close to the junc-

tion between it and the depressed body of the cell. Avicularia are wholly wanting*.

Genus ANARTHROPORA (part.), Smitt.

Der. From *ἀναρθρος*, unjointed, and *πόρος*, an opening.

LEPRALIA (part.), Busk.

GENERIC CHARACTER.—ZOECIA *with the oral extremity slightly produced and free, subtubular; orifice terminal, semicircular; an avicularian pore on the elevated portion of the cell in front; special pore wanting.* ZOARIUM (*in the British species*) *adnate.*

SMITT has united *A. monodon* with the two species of *Porina* in one genus. But the more I have examined the former, the less I have been inclined to adopt this course. It seems to exhibit points of divergence from the latter forms, which make it convenient to mark it off by a separate generic designation. We are not, of course, to understand by genera hardly-defined isolated provinces: such, indeed, it would be difficult to find. They merely represent phases or modifications, more or less marked, of the family type, and are set apart to indicate in a striking way its chief morphological variations. In framing them we do not look for hard-and-fast lines: they just as often suggest affinities as mark differences; they are simply landmarks in the morphological history of a tribe. The present form seems to me to have quite enough individuality to separate it from *Porina*.

The orifice in *A. monodon* is semicircular, instead of orbicular as in the latter. The shape indeed is affected

* Smitt, indeed, has figured a specimen with avicularia, obtained by Pourtales off the coasts of Florida (Flor. Bryoz. pt. ii. pl. vi. fig. 141), which he refers to this form; but I have little doubt that it is really a young colony of *Anarthropora monodon*.

by the thickening of the peristome, and is somewhat irregular in adult cells; but in its primary condition it is arched above and straight below. The special pore is absent; the opening which usually exists on the front of the elevated portion of the cell is merely avicularian, and is in no sense the equivalent of the raised tubular pore of the *Porinæ*.

ANARTHROPORA MONODON, Busk.

Plate XXXIII. figs. 10, 11.

LEPRALIA MONODON, *Busk*, Quart. Journ. Micr. Sc. vii. 213, pl. xxix. figs. 3, 4: *Norman*, Shetland Pol., Rep. B. A. 1868, 308.

ANARTHROPORA MONODON, forma MAJUSCULA, *Smitt*, Cefvers. &c., 1867, Bihang, 7 and 64, pl. xxiv. figs. 23, 24 (*not* figs. 20-22): *Hincks* (*A. monodon*), Ann. N. H. Dec. 1877, 528.

ANARTHROPORA MINUSCULA (part.), *Smitt*, Flor. Bryoz. pt. ii. pl. vi. fig. 141.

Zoæcia ovate below, somewhat depressed, above suberect, produced into a short neck; surface (in the adult state) reticulato-punctate, covered with stellate perforations; occasionally radiating ridges round the border; orifice (primarily) arched above, with the lower margin almost straight, often much contracted in the older cells; peristome much thickened, without spines; a circular hole in front, immediately below the inferior margin, placed centrally or at one side, which is frequently covered by an *avicularium*, with an acute mandible, directed obliquely upwards; on the upper margin also an *avicularium*, or, in its absence, a small circular pore. *Oæcia* unknown.

Colonies with a somewhat branching or dendritic habit of growth.

RANGE OF VARIATION. In young cells the surface is smooth and polished, and wants the rather coarse reticulated covering which characterizes the adult. In this condition the punctures are very distinct, and show their beauti-

fully stellate character. Calcification is carried to a great extent in this species; and the walls become very thick and solid, and rather coarse in appearance, as we might expect in a deep-water form. It is often difficult to determine the nature of the pore on the front of the neck-like prolongation of the cell. In the older zoœcia it is usually a simple circular opening of rather large size; but in the younger it shows its true character, and is covered by a pointed avicularium. The smaller pore on the upper margin, which is sometimes very conspicuous, is also avicularian; but the appendage itself is very generally wanting; when present, its mandible is directed downwards.

There is considerable variability in the shape of the orifice, which seems to be chiefly due to the thickening of the peristome with age.

HABITAT. On stones, shells, *Gorgoniæ*, &c., from deep water.

LOCALITY. Shetland, on shell (Barlee): *ibid.*, common in 80–170 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. North Sea, off Norway, on *Gorgoniæ* and stones from 200–300 fathoms (Baron Uggla): W. off Tortugas (Pourtales).

In *A. monodon* the zoœcia are distinct, but separated by shallow sutures, and very slightly convex, so that the zoarium has a flattish appearance. The stellate character of the punctures with which they are thickly covered, is hardly apparent except in young specimens. The oral extremity is slightly turned upwards; and the mouth is girt about with a massive peristome: the pore in the centre of the upper margin is the “tooth” which suggested the specific name.

At the base of the cells there is a row of circular openings.

Genus LAGENIPORA, *Hincks*.

Der. From *lagna*, a flask.

GENERIC CHARACTER.—COLONIES *consisting of a number of cells immersed in a common calcareous crust. ZOÆCIA decumbent, contiguous, lageniform; oral extremity free, tubular, with a terminal orbicular orifice.*

THE leading characteristic of this genus is the common calcareous crust, in which the cells composing the colony are more or less immersed. The zoarium is not a mere congeries of cells, laid side by side in a certain order, but consists of a calcareous matrix, in which a number of zoæcia are imbedded, and by which they are united into one commonwealth. The cells themselves bear a close resemblance to those of *Porina tubulosa*, but are destitute of the large tubular pore on the front wall, which is so striking a character of the latter form.

LAGENIPORA SOCIALIS, *Hincks*.

Plate XXXIV. figs. 7, 8.

LAGENIPORA SOCIALIS, *Hincks*, Ann. N. H. for September 1877, 215.

Crust whitish, granulated, of irregular figure. *Zoæcia* flask-shaped, the lower part immersed, the upper part (in adult cells) produced into an erect tubular neck; orifice circular, terminal, frequently with a number of spinous processes on the upper margin; surface granular, except on the erect portion, where it is smooth. *Oæcia* small, rounded, smooth, set far back behind the tubular neck of the cell.

Colonies forming small, rather thick white crusts.

HABITAT. On shells of *Pecten maximus*.

LOCALITY. Hastings (Miss Jelly).

The cells are irregularly disposed; but there is a tendency to a radiate arrangement around the central part of the colony. The crust varies much in form. In one specimen which came under my observation the colony consisted of three or four parallel rows of immersed cells, which are connected at intervals by crust and cells, so as to form an anastomosing structure. Probably as growth proceeded this would have been filled in and become a continuous expansion, which is the usual condition of the crust. In young cells the erect tubular portion is wanting, and the peristome is very slightly raised. In the adult the marginal spines are commonly absent, and when they occur seem to be irregularly developed. Sometimes there are two small spines in the centre of the upper margin, and on each side a spinous process (projection of the peristome). The peristome is somewhat everted. Round the base of the cell there are sometimes a number of indistinct punctures. The ovicell is placed at the back of the tubular neck below the aperture, and is very inconspicuous.

This interesting species has only been found, so far, on shells of the common scallop obtained from the Hastings fishermen.

Family XIII.—**Myriozoidæ** (part.), *Smitt*.

CELLEPORIDÆ (part.), Johnston.

PORINIDÆ (part.), D'Orbigny.

MEMBRANIPORIDÆ (part.), Busk.

MYRIOZOIDÆ (part.), Smitt, Kritisk Förteckn.

ZOARIUM *incrusting, or rising into foliaceous expansions,*

or dendroid. ZOECIA calcareous, destitute of a membranous area and raised margins ; orifice with a sinus on the lower lip.

THE oral sinus, as Smitt has remarked, is the representative of the median pore in the preceding family.

Genus SCHIZOPORELLA, *Hincks.*

Der. From σχίζω, I divide, and πόρος, an opening.

LEPRALIA (part.), Johnston : Busk : &c.

ESCHARINA (part.), D'Orbigny.

REPTOPORINA (part.), id.

ESCHARELLA, subgenus HERENTIA (part.), Smitt, Kritisk Förteckn.

MOLLIA, Smitt, ibid.

HIPPOTHOA (part.), id. Floridan Bryozoa.

GENERIC CHARACTER.—*ZOECIA with a semicircular or suborbicular orifice, the inferior margin with a central sinus. AVICULARIA usually lateral, sometimes median, with an acute, or rounded, or spatulate mandible ; occasionally wanting. ZOARIUM (in the British species) incrusting, or (occasionally) forming foliaceous expansions.*

I REGRET that I cannot adopt Prof. Smitt's name for this group, which he was the first to define. But the *Hippothoa* of authors is not, in my judgment, superseded or merged in other genera ; and the name must therefore be retained with its original application. I am not aware that there is any other existing designation which has any special claim to the vacant place, or, indeed, which could be employed without the risk of creating confusion.

a. *Avicularia with a pointed mandible, generally lateral.*

SCHIZOPORELLA UNICORNIS, Johnston.

Plate XXXV. figs. 1-5.

- BERENICEA COCCINEA, *Johnst.* Trans. Newc. Soc. ii. 267, pl. xii. fig. 5.
 LEPRALIA COCCINEA, *Johnst.* Br. Z. ed. 1, 278, pl. xxxiv. figs. 1-3.
 LEPRALIA UNICORNIS, *Johnst.* Br. Z. ed. 2, 320, pl. lvii. fig. 1: *Busk*, Quart. Journ. Micr. Sc. iv. 309, pl. x. figs. 3, 4; Crag Pol. 45, pl. v. fig. 4: *Alder*, North. Cat. 49: *Hincks*, Devon & Cornw. Cat. 41 (sep.).
 LEPRALIA SPINIFERA (part.), *Busk*, B.M. Cat. 69, pl. lxxx. figs. 5-7, pl. xci. figs. 1, 2: *Heller*, Bryoz. d. Adriat. Meer. 28 (vars. *unicornis* and *serialis*): *Manzoni*, var. *unicornis*, Bryoz. Plioc. Ital. prim. Contr. 7, pl. ii. fig. 11.
 LEPRALIA ANSATA, *Johnst.* B. Z. ed. 2, 307, pl. liv. fig. 12: *Busk*, Crag Pol. 45, pl. vii. fig. 2: *Hincks*, Dev. & Cornw. Cat., Ann. N. H. ser. 3, ix. 70: *Reuss*, Bryoz. österr.-ungar. Miocän, pt. i. 18, pl. vi. fig. 12: *Heller*, Bryoz. Adr. Meer. 29: *Manzoni*, Bryoz. foss. Ital. Contr. iii. 9, pl. ii. fig. 11.
 ? ESCHARINA ISABELLEANA, *D'Orb.* 'Voyage' &c., v. pt. 4, 12, pl. iv. figs. 13-16 (atlas in vol. ix.).
 LEPRALIA TETRAGONA, *Reuss*, Foss. Polyp. d. Wiener T. B. 78, pl. ix. fig. 19 (form *unicornis*): *Manzoni*, Bryoz. foss. Ital. Contr. iii. 8, pl. ii. fig. 10.
 LEPRALIA ANSATA, var. TETRAGONA, *Reuss*, Bryoz. d. österr.-ungar. Miocän, pt. i. 19, pl. vii. figs. 1, 2; var. *porosa*, l. c. 18, pl. vi. fig. 13.
 REPTOPORINA TETRAGONA, *D'Orb.* Pal. Fr. Ter. Cr. v. 442.
 ESCHARINA VARIABILIS, *Leidy*, "Mar. Invert. Rhode Isl. & New Jersey," Journ. Ac. N. Sc. Philadelph. ser. 2, iii. (1855-8), 142, pl. xi. fig. 37.
 ? MOLLIA VULGARIS, forma ANSATA, part., *Smitt*, l. c. Krit. Fört. pt. iv. 15 & 104, pl. xxv. fig. 80.

Zoæcia ovate or rectangular, distinct, separated by deep sutures, surface thickly punctured, often silvery, disposed in linear series; orifice semicircular, lower margin straight, with a well-marked central sinus, peristome not raised; a pointed mucro of varying length, a little below the orifice, and on each side of it (or on one) an *avicularium*, sometimes nearly on a level with the lower margin, the acute mandible directed obliquely outwards,

sometimes placed near the top of the cell, and pointing straight upwards. *Oæcia* globose, prominent, rather smooth in front, with grooves radiating from the centre towards the base.

Polypides large, with a remarkably long œsophagus of a greenish-yellow colour; tentacles 18, forming a very tall and graceful bell.

Form ANSATA. *Zoæcia* short, broad, and squarish, usually granular, and with a raised line round the border; mucro often rudimentary. *Oæcia* small, very closely united to the cell above, indistinctly grooved.

Colonies forming large spreading crusts, often (in the littoral variety) of a beautiful silvery whiteness.

RANGE OF VARIATION. The forms which Johnston named *Lepralia unicornis* and *L. ansata* must be referred to one species; there are no characters of any importance separating the one from the other. *L. ansata*, as commonly understood, represents a deep-water condition of the species, distinguished by its short, broad zoæcia with dense and usually granulous walls and a somewhat flat surface, and by its small ovicell, on which, owing to the thickened and incrustated state of the zoarium, the peculiar sculpture is inconspicuous. All the essential characters are identical in the two forms. The shape of the zoæcium has been taken as the distinctive feature of *L. ansata*; but this is a most variable character; and although there is no doubt a variety specially distinguished by its short, broad cells, yet this type of cell is commonly found along with the more elongated form on the same specimen.

In breadth and length, and in the proportion of breadth to length, the zoæcia vary endlessly. They are found very broad and almost square, at times broader than long; rectangular, but elongate, sometimes much produced and very narrow; ovate, and occasionally subglobose. No

specific distinction can be founded on so unstable an element. As to sculpture, the puncta are generally absent on the deep-water form, being obliterated by the dense crust which involves the surface; but traces of them may almost always be met with on the young marginal cells.

The avicularia are sometimes present on both sides of the cell, frequently on one side only; and in many cases they are wanting altogether. They also vary slightly in position, as I have pointed out in the diagnosis of the species. Besides the oral avicularia, there are occasionally others, irregularly placed. Sometimes one is developed at the bottom of the cell, with the mandible pointing downwards or sideways; and I have seen one on each side of the mucro, a little below the aperture. The species seems to be very liable to "sports." Occasionally the surface of the cell presents a very singular appearance, being studded with umbonate processes of various shapes and sizes (Plate XXXI. fig. 4). The usual mucro is now largely developed, so as to form a prominent spike, and now, especially in the deep-water variety, almost abortive.

I have also met with another very remarkable *lusus*. On a specimen from deep water, a cell has the ovicell developed *below* the mouth and reversed, so that the aperture faces towards the lower margin. In several instances, too, on the same specimen, a second ovicell occurs on the cell, at one side, so placed as to cover, or partially cover, one of the lateral *avicularia*. This monstrosity is of peculiar interest, inasmuch as the growth of an ovicell immediately above and overarching the avicularium is an indication of the morphological significance of this structure, as a modified zoecium.

HABITAT. On rock and under stones and on *Laminaria*

in the littoral region, and on stones, shells, &c., from deep water.

LOCALITIES. Very widely distributed.

Form *unicornis*. Guernsey; South Devon (one of the commonest littoral species); Ilfracombe; Filey (T. H.): Northumberland and Durham (Alder): St. Andrews (Dr. M'Intosh): Ayrshire (Landsb.): the Minch (A. M. N.): &c.

Form *ansata*. Shetland, 40–170 fathoms, extremely abundant; the Minch (A. M. N.): Antrim (Hyndman): Hastings (Miss Jelly): Cornwall, 30–40 fms. (T. H.): &c.

GEOGRAPHICAL DISTRIBUTION. Form *unicornis*:—Adriatic (Heller): Naples (A. W. Waters): Gibraltar Bay (Landsb.): France, S.W. (Fischer): North America (Leidy): Durban, South Africa* (W. Oates). Form *ansata*:—Greenland ('Valorous' dredgings). Bergen, both forms (A. M. N.).

RANGE IN TIME. Form *unicornis*:—Coralline Crag (S. Wood): Vienna Basin; Austro-Hungarian Miocene (Reuss): Italian Pliocene (Manzoni): Scotch Glacial deposits (Geikie): Palæolithic (A. Bell). Form *ansata*:—Coralline Crag (S. Wood): Vienna Basin (Reuss): Ital. Pliocene (Manzoni): Palæolithic (A. Bell).

SCHIZOPORELLA SPINIFERA, Johnston.

Plate XXXV. figs. 6–8.

LEPRALIA CILIATA, Hass. Ann. N. H. vi. 171, & vii. 367, pl. ix. fig. 2: Couch, Corn. Faun. iii. 118, pl. xxii. fig. 10.

* The South-African specimens are extremely beautiful. The surface of the zoarium is silvery and lustrous, and of the most remarkably delicate texture; the wall of the cells is reticulated, the punctures appearing as very deep perforations in a thick vitreous crust. The ovicell is more or less punctured in addition to the usual sculpture, and the cells are very regular in form and arrangement. The specimens show very plainly the influences of climate.

- LEPRALIA SPINIFERA, *Johnst.* B. Z. ed. 2, 324, pl. lvii. fig. 6: *Busk* (in part), B.M. Cat. 69, pl. lxxvi. figs. 2, 3: *Hincks*, Devon & Cornw. Cat., Ann. N. H. ser. 3, ix. 201 (41 sep.).
- MOLLIA VULGARIS, forma SPINIFERA, *Smitt*, Cefv. K. Vetensk.-Akad. Förh. 1867, Bihang, Krit. Förh. iv. 15 & 103, pl. xxv. fig. 78.
- LEPRALIA SPINIFERA, var. ACULEATA, *Heller*, Bryoz. Adriat. Meer. 28.

Zoæcia rhomboid, convex, smooth or slightly roughened, silvery, often indistinctly punctured; orifice ample, arched above, lower margin straight, with a large rounded sinus in the centre; peristome thin and not raised; 5-7 large and stout oral spines; a little below the orifice a central mamilla, to which a horn-coloured spine is articulated, and on one side of it a large, raised *avicularium*, pointing outwards, mandible much produced and very slender towards the extremity, projecting beyond the beak. *Oæcia* prominent, subglobose, smooth and somewhat flattened in front, with ribs radiating towards the base.

Primary cell short, raised, the top occupied by a large oval aperture, with a membranous covering, and about ten stout marginal spines (woodcut, fig. 13).



Fig. 13.
Primary cell.

RANGE OF VARIATION. Instead of one corneous spine below the aperture, there are sometimes two, close to one another, and occasionally as many as three or four ranged in a line across the cell.

The *avicularium* is always single, I believe, and is placed indifferently on either side. It is often absent.

There seems to be little variation in the form or size of the cells or in the general character of the zoarium, as we might naturally expect, remembering the very limited bathymetrical range of the species.

HABITAT. On stems and roots of *Laminaria* and other weeds chiefly, more rarely on stones, &c., between tide-marks and in shallow water; occasionally from deep water.

LOCALITIES. Shetland (A. M. N.): St. Andrews, very common (Dr. Mcintosh): Wick and Peterhead, on stones from deep water and between tide-marks (C. W. P.): Lamlash; Llandudno; Isle of Man; South Devon; Ilfracombe (T. H.): Hastings (Miss Jelly): Dublin Bay (Hassall).

GEOGRAPHICAL DISTRIBUTION. Bahusia, on sea-weeds, not common, 10-12 fathoms (Smitt): Adriatic, rare, on stones (Heller).

SCHIZOPORELLA ALDERI, Busk.

Plate XXXVI. figs. 9, 9 a, 10.

ALYSIDOTA ALDERI, *Busk*, Quart. Journ. Micr. Sc. iv. (1856), 311, pl. ix. figs. 6, 7: *Norman*, Shetland Pol., Rep. B. A. 1868, 306.

LEPRALIA BARLEEI, *Busk*, Quart. Journ. Micr. Sc. vii. (1860), 143, pl. xxvi. figs. 1, 2.

MOLLIA VULGARIS, forma ANSATA, Hippothoid var., *Smitt*, l. c., Krit. Fört. iv. 15 & 104, pl. xxv. fig. 81, (?) 79.

Zoæcia broad-ovate, distinct, subgranular, sometimes punctured, glossy, irregularly massed together, or disposed in a single branching series; orifice arched above, inferior margin straight, with a central notch; immediately below the mouth an umbo; occasionally a small *avicularium* with acute mandible, pointing obliquely downwards, on one side a little below the mouth, rarely on both sides. *Oæcia* globose, prominent, smooth, usually with a central umbo.

RANGE OF VARIATION. This species assumes two very distinct modes of growth. The cells are either massed together, so as to form a continuous crust, or they run out into chain-like linear series, which send off branches in a dendritic fashion.

There is a striking contrast in habit between the two

varieties; but the cell is identical in both*. The branches originate in pairs from the top of a cell, diverging gradually as they lengthen.

The avicularium of this species has been generally overlooked, but is figured by Smitt. It is very sparingly developed. When it occurs, it is usually single; but occasionally there is one on each side of the cell. Beyond the superficial differences, dependent principally on age, there is no further variation in *S. Alderi* that requires any special notice.

There is a row of large punctures round the base of the zoæcium.

HABITAT. On stones, shells, &c., from deep water.

LOCALITY. Shetland, common, 50–170 fms. (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Hammerfest, 40–60 fathoms (Lovén): Bergen (A. M. N.): Southern Norway, on *Astarte* (Dr. Boeck).

SCHIZOPORELLA VULGARIS, Moll.

Plate XXXVII. fig. 7, and Plate XV. figs. 5, 6.

ESCHARA VULGARIS, *Moll*, *Seerinde*, 55, pl. iii. fig. 10.

ESCHARINA VULGARIS, *Lamk.* An. s. V. ed. 2, ii. 231 (excl. syn. *E. Dutertrei*).

CELLEPORA VULGARIS, *Lamx.* Pol. Cor. flex. 94.

LEPRALIA VULGARIS, *Busk*, Quart. Journ. Micr. Sc. vi. 127, pl. xviii. fig. 3:
Hincks, Devon & Cornw. Cat. 43 (sep.); Ann. Nat. Hist.
ser. 3, ix. 203.

LEPRALIA ALBA, *Hincks*, Quart. Journ. Micr. Sc. viii. 275, pl. xxx. figs. 2, 2 a.

CELLEPORA OTOPHORA, *Reuss*, Polyp. d. Wiener Tertiärbeckens, 90, pl. xi.
fig. 1.

LEPRALIA OTOPHORA, *id.* Sitz. d. kais. Ak. d. Wissensch. Bd. L. 25, pl. xv.
fig. 1; Bryoz. d. deutsch. Septar. 62 (sep.), pl. vii. fig. 4.

? LEPRALIA COGNATA, *Reuss*, Bryoz. d. deutsch. Septar. 62, pl. vii. fig. 5.

* We have similar varieties in *Phylactella labrosa*, *Busk*, and *Membranipora monostachys*, *id.*

LEPRALIA INTERMEDIA, *Reuss*, Bryoz. d. österr.-ungar. Miocän, 20, pl. viii.
fig. 11 (granular var.).

MOLLIA VULGARIS, forma TYPICA, *Smitt*, l. c. 14.

Zoæcia oval or rhomboid, convex, distinct, smooth or subgranular; orifice well arched above, the inferior margin straight, with a notch in the middle, occasionally a central mucro a little below it; oral spines four or five; an *avicularium* on each side, about halfway down the cell, or, in some cases, nearer to the top, with a long and slender vibraculoid mandible. *Oæcia* small, subglobose, smooth, united to the cell above, sometimes umbonate.

RANGE OF VARIATION. I have noticed the smallest amount of variability in British examples of this species. The cells are more or less granular, a difference of no significance whatever, and disposed sometimes irregularly, sometimes in lines.

In a beautiful Mediterranean specimen, for which I am indebted to Mr. Waters, there is a mucro on the front of the cells, which sometimes attains a considerable length, and a prominent umbo on the oecium (Plate XV. figs. 5, 6).

On the whole, there are few species more constant in character.

HABITAT. On stones, shells, weeds, &c., from moderate depths to deep water.

LOCALITIES. South-west of Polperro, 30 fathoms (T. H.): coast of Antrim, deep water (Hyndman): Hastings (Miss Jelly): Birterbuy Bay (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Moll): Naples, on *Sargassum* (A. W. Waters): Madeira (J. Y. J.).

RANGE IN TIME. Vienna basin (Reuss): Austro-Hungarian Miocene deposits, granular var. (Reuss): Pliocene deposits, Brucoli, Sicily (A. W. Waters).

The appendages in this species resemble in character

those of *Microporella ciliata*; they are placed on small, somewhat oval risings on the cell-wall. The mandible is much elongated and attenuated above, and bears a decidedly vibraculoid appearance; but it is expanded and flattened towards the base, and the fixed beak is present, though in a rudimentary condition. They are properly ranked as avicularia, but exhibit a transitional form.

SCHIZOPORELLA SIMPLEX, Johnston.

Plate XXXV. figs. 9, 10.

LEPRALIA SIMPLEX, *Johnst.* B. Z. ed. 2, 305, pl. liv. fig. 4: *Gray*, B.M. Rad. 118: *Busk*, B.M. Cat. ii. 82, pl. lxxxiv. figs. 1, 2: *Hincks*, Dev. and Cornw. Cat. 44 (sep.); Ann. N. H. ser. 3, ix. 204.

Zoæcia ovate, ventricose, very distinct, separated by deep sutures; walls smooth, dense, greyish white; orifice suberect, arched above, lower margin straight, with a large central sinus; peristome elevated and thickened, forming a wall round the entire aperture; below the mouth an umbo; sometimes a small *avicularium* on one side, about halfway down the cell, placed transversely, mandible acute, directed outwards. *Oæcia* globose, ample, smooth, usually with two or three umbonate processes in front; peristome in the fertile cells much developed, forming a prominent, everted, semicircular border.

RANGE OF VARIATION. This is quite one of the least variable of its tribe. The characters are strongly marked and very constant. The avicularium, which has hitherto been overlooked, is often absent, and seems never to be developed on more than a few cells in each colony.

HABITAT. On stones, shells, &c., from moderate depths.

LOCALITIES. Off Sana Island, 40 fathoms; coast of Antrim, very abundant (Hyndman): Belfast Bay, 20-35

fathoms (W. T.) : South Devon, rare ; Guernsey (T. H.) : Hastings (Miss Jelly) : Hebrides (A. M. N.) : Unst, Shetland, 45 fathoms ; Peterhead and Wick (C. W. P.).

DISTRIBUTION IN TIME. Scotch Glacial deposits (Geikie).

The elevated, subtubular peristome, half concealing the orifice, gives a very remarkable appearance to this species, and somewhat interferes with the recognition of its real affinities. But the form of the mouth and the lateral avicularium are characters which clearly connect it with the present group. It seems to be local in its distribution, and has only been found abundantly at one or two points.

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SCHIZOPORELLA LINEARIS, Hassall.

Plate XXXVIII. figs. 5-10, and Plate XXIV. fig. 1.

LEPRALIA LINEARIS, *Hass.* Ann. N. H. vii. 368, pl. ix. fig. 8: *Johnst.* B. Z. ed. 2, 308, pl. liv. fig. 11: *Busk*, B.M. Cat. ii. 71, pl. lxxxix. figs. 1-3: *Manzoni*, Bryoz. fossil. Ital., Contrib. iii. 5 (sep.) pl. i. fig. 4; Sitzb. k. Akad. d. Wissensch. Bd. lx. 1. Abth. Dec.-Heft, 1869: *Norman*, Shetland Polyz., Rep. Brit. Assoc. 1868, 306: var. *hastata*, *Hincks*, Dev. Cat., Ann. N. H. ser. 3, x. 362.

HERENTIA LINEARIS, *Gray*, B.M. Rad. 123.

LEPRALIA HASTATA, *Hincks*, Dev. and Corn. Cat., Ann. N. H. ser. 3, ix. 206 (46 sep.), pl. xii. figs. 4, 4a.

ESCHARELLA LINEARIS, forma 1, *Smitt*, Öfvers. K. Vet.-Ak. Förh., Bihang, 1867, Krit. Fört. iv. 13 and 95, pl. xxiv. figs. 68, 69.

LEPRALIA TENELLA, *Reuss*, Foss. Bryoz. d. österreich.-ungarisch. Miocäns, 23, pl. vi. figs. 3-5.

Zoæcia rhomboidal, depressed, disposed in regular linear series, and separated by raised lines, sometimes confluent and forming a uniform crust; the surface flat, nodulous or covered with anastomosing ridges, and punctured, or enveloped in a granular crust; orifice orbicular, slightly rimmed, with a pointed sinus below; marginal spines 2-4; occasionally a central mucro a

little below the mouth; a small raised *avicularium* on each side of the orifice, almost in a line with the lower margin; mandible acute, directed obliquely downwards or straight across, sometimes replaced by a large central avicularium, pointing upwards. *Oæcium* globose, prominent, somewhat flattened in front, and thickly punctured; frequently a large avicularium at the back of it, placed transversely.

Colonies forming large rose-coloured crusts.

Var. *a* (*hastata*, Hincks). Orifice with a broad, shallow sinus on the inferior margin; immediately below it a tall, sharply pointed mucro, expanded at the base, tapering towards the apex, bearing on one side or the other at the bottom a large avicularium, with a pointed mandible directed upwards; surface thickly covered with rather large punctures and intersected by ridges, which are sometimes arranged in radiating fashion. (Plate XXXIII. figs. 10, 10 *a*.)

Var. *β* (*mamillata*). *Zoæcia* tumid, irregularly disposed; a single avicularium immediately below the oral sinus, borne on a mamillary enlargement of the front wall; mandible directed straight outwards.

Var. *γ* (*nitida*). *Zoæcia* much more elevated than usual, bright and lustrous, the front wall ascending towards the large and massive mucro, from which ridges radiate towards the sides, anastomosing, and rising into many nodulous processes; an avicularium on each side of the mouth, pointing obliquely outwards.

Var. *δ* (*crucifera*, Norman). "With a central, suboral process rising from the cell in the form of a very long, gradually tapering, rugose, perpendicular spine, which is more than equal to the length of the entire cell, and in its most perfect state gives off a branch at nearly right angles at rather more than half its length, so that the whole process is in the form of a cross or trident." Sometimes a branch is developed near the base of the mucro, and a second towards the upper extremity.

RANGE OF VARIATION. Apart from the usual superficial differences dependent upon the degree in which the calcareous crust is developed, the chief variation in this well-marked species takes place in the position, size, and direction of the avicularia. Normally there are two, which usually occupy corresponding positions on each side of the cell, though in some cases there is a great deal of irregularity. Frequently, however, these are replaced, on one and the same colony, by a single central avicularium, which is often very prominent and of large size. In some cases the avicularium is borne on the side of a short rostrum, placed a little below the oral sinus. Occasionally a large raised avicularium is met with near the bottom of the cell, placed transversely; and the oecium is sometimes attended by one or two, in addition to the oral pair.

In an Algerian specimen the latter are placed almost close together, facing one another, below the inferior margin of the mouth, and are larger and much more elevated in front (almost vertical) than in the usual form. In another very marked variety (*mamillata*), which is also from Algiers, the avicularium is single, placed immediately below the oral sinus, and borne on a mamillary enlargement of the front wall of the cell, the mandible pointing straight outwards. The position is constant and invariable; the cells are granular, tumid, and irregularly disposed; and there is (in the specimen which I have examined) a total absence of the rudimentary ovicelligerous cells that are so characteristic of *S. linearis*. This has somewhat the appearance of a distinct species; but, on the whole, and especially considering the great variability in the position of the avicularium, which distinguishes the present form, I believe that it is more properly ranked as a variety.

The direction in which the mandible of the avicularium points is also very variable in this species: most commonly it is placed transversely; but very often it is turned straight upwards, or obliquely downwards or outwards.

The mucronate process, which is often present below the mouth, is likewise subject to many diversities in the degree of its development. In some cases it is absent altogether; in others it is small and inconspicuous; in others again (as in the var. *crucifera*) it rises into a tall and slender spine, which gives off one or more branches. In this form it is occasionally double; the ovicell is sometimes developed round one of the two spines, the extremity of which appears as a spike-like process on the front of it. In the Mediterranean variety (*nitida*) the mucro is large and massive, and traversed by radiating ridges.

The variety *hastata* presents some very striking features; and I at one time regarded it as a distinct species. The tall mucronate processes, each with a rather large lateral avicularium at the base, are profusely developed; the orifice has a broad sinus on its inferior margin; the zoarium is usually white and silvery; and the surface is covered with large punctures, which often assume a radiated arrangement. The oecium has not unfrequently a mucro at the top.

HABITAT. Under stones, near low-water mark, and on shells, stones, &c., and more rarely on Algæ, from shallow to very deep water.

LOCALITIES. Very abundant and generally distributed. Shetland, common down to 170 fathoms. Var. *crucifera*:—On a shell dredged in 40–50 fathoms off Unst (A. M. N.): Orkney (Barlee): Ireland, north and west (W. T.): Birterbuy Bay (G. S. Brady): Beaufort Dyke, 110–147 fathoms (Capt. Bcechey): Filey, Yorkshirc, between tide-

marks; South Devon; Ilfracombe, 8-10 fathoms; Cornwall, down to 60 fathoms (T. H.): &c. Var. *hastata*:—South Devon; Guernsey (T. H.): Budleigh-Salterton, very fine (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): France, S.W. (Fischer): Mediterranean (M'Andrew): Adriatic (Heller): Algiers, normal and var. *mamillata* (J. Y. J.): Scandinavia, on Ascidians and Algæ, 10-20 fathoms (Smitt): Norway, from 200-300 fathoms, on *Oculina* (Baron Uggle): Bohuslän (Lovén): South Labrador, rare (Packard).

RANGE IN TIME. Austro-Hungarian Miocene deposits (Reuss): Pliocene beds, Calabria (Manzoni).

I have already referred incidentally to the curious rudimentary cells bearing oœcia, which are developed abundantly on this species. They occur on the front surface of the ordinary zoœcium, which they almost completely cover. The upper portion presents the usual appearance of the ovicell; it is closely united to the wall of the cell, ample, well rounded above, but contracted slightly towards the arched opening in front, which is closed by a horn-coloured operculum. Below the opening there is a semi-circular calcareous wall, continuous with the sides of the ovicell; and between the top of this wall and the operculum there is a space, which is usually filled in by a transparent membrane. The area inclosed by the semicircular wall is evidently an aborted cell. The whole structure consists of an oœcium attached to the mere rudiment of a cell.

These singular bodies are in most cases distributed thickly over the surface of the zoarium, and occur indifferently on cells which are furnished with the ordinary ovicell and on those which are destitute of it. Occasionally they are placed transversely.

They may be compared with the ovicelligerous cells of *S. hyalina* or of *Eucratea*, which are more or less imperfectly developed. In the former the fertile zoœcia are produced upon the primary layer of cells, and are always atrophied and small in size, closely resembling in character and position the structures in question. The peculiarity in the present species seems to be that the two conditions of the fertile cell coexist. *Eschara Brongniartiana*, D'Orb.*, from Chili, is furnished with a large number of similar structures distributed over the surface of the cells.

Another peculiarity of this species should be noticed—the tendency to the development of single cells and groups of cells over the surface of the zoarium, forming in fact a second layer. These secondary cells are more tumid than the primaries, and very irregularly disposed. They never exhibit the precise linear arrangement which characterizes the latter, but are strewn, as it were, over the primitive layer.

SCHIZOPORELLA SANGUINEA, Norman.

Plate XXXIX. figs. 6, 7.

HEMESCHARA SANGUINEA, *Norman*, Quart. Journ. Mier. Sc. (n. s.) viii. 222, pl. vii. figs. 9–11.

ESCHARELLA SANGUINEA, *Smitt*, Flor. Bryoz. pt. ii. 54, pl. viii. figs. 164, 165.

Zoœcia subquadrangular, arranged with great regularity in linear series, quincuncial, flattened, bordered by raised lines, thickly covered with large, circular perforations, the perforations sometimes separated by nodulous reticulated ridges; orifice arched above, a central sinus on the lower margin, and on each side of it a very small notch-like indentation. Sometimes a small *avicularium*,

* Voyage dans l'Amér. mérid., vol. v. part 4, page 14, pl. vi. fig. 12.

with subacute mandible, on each side of the aperture at the very top of the cell, and others distributed over the zoarium. *Oæcia* subglobose, tumid, punctured, and nodulous.

Colonies incrusting, or "rising in frill-formed, free expansions, consisting of a single series of cells" [Norman]; or "in tubiform convolutions" [Smitt]; shining, and of a deep red colour.

RANGE OF VARIATION. *S. sanguinea* is often strongly calcified, and it changes much in appearance according to the degree in which the stony crust is developed. The habit of growth is also variable to some extent; and though it commonly takes the form of a spreading crust, it also rises at times into free expansions, consisting of a single layer of cells. The detachment and upward growth of the cellular lamina, unaccompanied by any change in the plan of budding and the structural composition of the zoarium, is a very trivial variation; and the genus *Hemeschura*, which is based on this character, has certainly no claim to stand.

The avicularia in this species, according to Prof. Smitt, are variable in position, number, and size; in their most normal arrangement, he says, they are placed one on each side of the orifice. They are often either wanting altogether, or are overgrown and concealed by the calcareous crust.

I have a Mediterranean form which agrees closely with the present, but has three small avicularia, placed in a line below the orifice, with a rounded mandible.

HABITAT. On shells and stones, &c., in rather deep water.

LOCALITIES. Off Fermain Bay, Guernsey, on shells and *Eschara* (A. M. N.): on stones, Cornwall, deep water (T. H.).

GEOGRAPHICAL DISTRIBUTION. Florida, south-west of Tortugas, in 60 fathoms (Pourtales): Naples (A. W. Waters).

SCHIZOPORELLA CRISTATA, Hincks.

Plate XL. figs. 6, 6 a.

SCHIZOPORELLA CRISTATA*, *Hincks*, "On the Classification of British Polyzoa," Ann. N. H., February 1879, 157.

Zoæcia small, short-ovate, or rhomboidal, distinct, convex, divided by rather deep sutures; surface silvery, smooth, or slightly furrowed, with a few punctures; orifice sub-orbicular, with a central sinus below, and five marginal spines; immediately under the lower margin a prominent mucro, from which the elevated peristome passes off on each side, forming with it a wall round a large proportion of the orifice; on the inner side of the mucro a very small and delicate *avicularium*, with pointed mandible directed straight upwards. *Oæcia* (proportionally) large, subglobose, punctured, with an erect, crest-like ridge running across them at the top.

Primary cell very small, suborbicular, sides sloping steeply upwards, the summit occupied by an oval area, at the upper part of which is placed the semicircular orifice, sinuated below; six spines round the orifice, and three on the lower border of the area.

HABITAT. On the shell of the scallop.

LOCALITY. Hastings (Miss Jelly).

I have only seen a single colony of this very beautiful species, consisting of the primary and about sixteen other cells, which, from their freshness, have a remarkably bright, glossy, subhyaline appearance. I have no doubt that with age it undergoes very considerable change in superficial character.

* This species was first labelled (in MS.) *nitidula*, and appears under this name, without description, in the List of Polyzoa published by the Natural-History Society of Hastings and St. Leonards (1878). I have changed it, that the specific designation may be founded on a permanent character, and not on one which is probably fugitive.

The cells are decidedly convex and very distinct, the wall sloping up rather abruptly from the base towards the centre. The mucro forms the middle point of the wall, which incloses the orifice in front and at the sides, and rises above it like a pillar. The avicularium on its inner aspect is minute, and not easily detected. The ovicell is large, and covers the whole of the front of the cell above it; the surface is silvery, and thickly perforated below the prominent crest which crowns it.

b. *With rounded or spatulate avicularia, lateral or median.*

SCHIZOPORELLA BIAPERTA, Michelin.

Plate XL. figs. 7-9.

ESCHARA BIAPERTA, *Michelin*, Icon. Zooph. 330, pl. lxxix. fig. 3.

LEPRALIA BIAPERTA, *Busk*, Crag Pol. 47, pl. vii. fig. 5: *Manzoni*, Bryoz. d.

Pliocene Antico di Castrocaro, 21, pl. ii. fig. 28 *.

REPTOPORINA BIAPERTA, *D'Orb.* Pal. franç. Terr. Crét. 442.

ESCHARELLA LINEARIS, forma BIAPERTA, *Smitt*, Cefv. K. Vetensk-Ak. Förh.

1867, Bihang, 14 & 98, pl. xxiv. figs. 70, 73.

HIPPOTHOA BIAPERTA, *Smitt*, Flor. Bryozoa, pt. ii. 46, pl. viii. figs. 173-176.

HIPPOTHOA DIVERGENS, *id.* Flor. Bryoz. pt. ii. 47, pl. ix. figs. 177, 179.

Zoæcia ovate, slightly convex, quincuncial; surface smooth and shining, the front wall perforated in the young state; orifice suborbicular, with a sinus, more or less open, below; peristome not raised, except in the fertile cells, in which it forms a wall round the front of the cell; on each side of the mouth a small, round,

* Manzoni describes the species from the Castrocaro beds as having a vibraculum on each side of the orifice, and an avicularium on the lower part of the cell. But the real nature of the lateral appendages would not be apparent in fossil specimens; and the openings left by the small, rounded avicularia which occur on *S. biaperta* might easily be mistaken for "vibracular pores." The avicularium on the front of the cell in Manzoni's description corresponds with the large elevated avicularium, with a pointed mandible, which is found on the recent species.

elevated *avicularium*; mamillæ scattered here and there over the zoarium, bearing large *avicularia*, with a slender, pointed mandible. *Oæcia* rounded, broader than long, somewhat flattened in front, the base enveloped by a thick layer, which incloses a semicircular space, traversed by radiating lines.

Colonies forming rather large, irregular crusts; the cells sometimes disposed in detached series (forma *laxa*, Smitt).

Form *eschariformis* (A. W. Waters). *Zoarium* erect and foliaceous.

RANGE OF VARIATION. Smitt has described as a new species, under the name of *Hippothoa divergens*, a Floridan form which, I confess, seems to me to be identical with *S. biaperta*. The only distinction between them, so far as his descriptions enable me to judge, of any importance, is a slight difference in the form of the mouth. In Michelin's species (= *Hippothoa biaperta*, Smitt) the sinus appears to be smaller, and to partake more of the character of a notch in the centre of the lower margin. In the *divergens* form, to which all the British specimens which I have seen are referable, the suborbicular orifice is produced below into an open, wedge-shaped sinus, the peristome usually slants gradually away to the bottom of it, and there is only a slight constriction of the aperture on each side. But there are many intermediate variations; and remembering the diversities in this particular that are met with in such a species as *S. auriculata*, it is difficult to regard this difference as possessing any great importance. The shape and general character of the cell, and the structure and position of the lateral *avicularia*, are, I believe, the same in both forms. In both, the *mamillæ*, supporting large *avicularia* with a pointed mandible, are present, and often in considerable numbers.

The ovicells of *Hippothoa divergens* are not described by Smitt; but on Algerian specimens in my possession, which exhibit the characters of this variety, they are developed abundantly, and they are identical with those figured by Smitt for the *biaperta* form. On the whole, I can see no reason for making two species, and I therefore unite the varieties under Michelin's original name.

Besides the differences in the contour of the mouth, to which I have just referred, there are others in the superficial characters.

In British specimens the walls are solid and compact, perfectly smooth, of a glossy white colour, and imperforate. In the Algerian examples the walls are thinner, and the texture much more delicate. The Crag form, figured by Busk, has a perfectly smooth surface, and has an avicularium on one side of the mouth only. In recent specimens there are more usually two, one on each side; but in some cases a single oral avicularium occurs.

Smitt assigns to *S. biaperta* a row of punctures round the margin, which I have not observed in British specimens. Their absence may be due to a different degree of calcification.

The number of the large, mamillated avicularia varies in a remarkable manner. Sometimes they are scarcely to be met with; sometimes they occur in wonderful profusion, as on the Algerian specimens, in which almost every cell, in certain portions of the colony, bears a large mound, covering the greater part of the front surface. The avicularia are placed on the side of these mound-like prominences, the extremity of the "beak" just reaching to the summit. The mandible is broad at the base, and tapers off rapidly to a point.

In this and the allied species, *S. armata*, we have a striking illustration of the variability of the avicularium;

in one case the rounded and the spatulate, in the other the rounded and the pointed forms, are associated.

The *Lepralia plana*, Dawson, from the Gulf of St. Lawrence and the Canadian Postpliocene deposits, is an allied but distinct species.

HABITAT. On stones and shells, from shallow to deep water.

LOCALITIES. Var. *divergens*:—Guernsey (A. M. N.): Hastings, on scallop-shells (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Var. *divergens*:—off the coast of Florida, 135 fathoms (Pourtales): Algiers (J. Y. J.). Var. *biaperta*:—Spitzbergen and Greenland, not frequent (Smitt): Kara Sea (Stuxberg and Théel): Floridan Sea, very common (Pourtales).

RANGE IN TIME. English Crag (Busk): Older Pliocene, Castrocaro (Manzoni): Miocene, Doué, France (*fide* Waters). Forma *eschariformis*, Sicilian Pliocene, Brucoli (A. W. Waters).

SCHIZOPORELLA ARMATA, Hincks.

Plate XLI. figs. 7, 8.

LEPRALIA ARMATA, *Hincks*, Devon and Cornw. Cat., Ann. N. H. ser. 3, ix. 207 (47 sep.), pl. xii. fig. 5.

Zoæcia rather broad, ovate, distinct, quincuncial; surface granular, sometimes punctured round the margin; orifice orbicular, with a deep, loop-like sinus below; peristome raised and thickened in front and at the sides; oral spines four or five, very tall and stout, two or three placed on the upper margin, and two lateral, the latter projecting in front of the ovicell; on each side of the orifice, near the top, a raised process bearing a small *avicularium*, with a semicircular mandible

directed outwards, often replaced by a large spatulate *avicularium*. *Oæcia* semicircular, rather shallow, flattened in front; surface smooth, with obscure radiating ridges.

Colonies forming large brownish or grey patches.

HABITAT. On stones, &c., from deep water.

LOCALITY. South-west of Polperro, in 30 fathoms (T. H.).

GEOGRAPHICAL DISTRIBUTION. Algiers, on shell (J. Y. J.).

The cells in this strongly marked species are moderately convex, well defined, arranged very regularly in quincunx, and coarsely granulated. The orifice is rather large, and appears to be deeply depressed from the elevation of the cell-wall around it; it is filled in by a light horn-coloured operculum, which bears a very close resemblance in form to a balloon. In fresh specimens the spines are a very conspicuous feature; they are stout, and of remarkable length. The two foremost are articulated to a short, tubular process; and when the ovicell is present, they stand erect in front of it, and rise high above it. There is sometimes an *avicularium* on each side of the orifice, sometimes on one side only. The semicircular mandible is turned outwards; it is interesting to note that on the lower margin of the *avicularian* aperture there is a minute sinus corresponding to the larger one on the mouth of the cell. The small *avicularia* are placed at the upper extremity of an ascending process; occasionally they are situated rather below the inferior margin; but their more usual position is near the top of the cell. Not unfrequently their place is occupied by a very different structure. Instead of the small rounded form, there often occurs an elongate *avicularium* of large size, with a spatulate mandible, usually, but not universally, pointing

upwards, and elevated above the surface of the cell. These large avicularia are also scattered irregularly over the zoarium.

SCHIZOPORELLA AURICULATA, Hassall.

Plate XXIX. figs. 3-9.

LEPRALIA AURICULATA, *Hass.* Ann. N. H. ix. 412: *Johnston*, B. Z. ed. 2, 310, pl. liv. fig. 8: *Busk*, B.M. Cat. ii. 67, pl. lxxxix. figs. 4-6.

ESCHARELLA AURICULATA, *Smitt*, Cfv. K. Vet.-Ak. Förh. 1867, Bihang, Krit. Förteckn. iv. 12 & 90, pl. xxiv. figs. 58, 59.

LEPRALIA OCHRACEA, *Hincks*, Dev. and Cornw. Cat., Ann. N. H. ser. 3, ix. 206, pl. xii. fig. 3.

Zoœcia rhomboid, occasionally subovate, short, depressed, disposed in linear series, radiating from a central point, separated by raised lines, punctured or granular, sometimes covered with a thick reticulated crust; orifice suborbicular, with a sinus below; marginal spines 2-4; a small *avicularium*, with rounded mandible, immediately below the centre of the lower lip, usually on a mamillary eminence, which is sometimes prolonged into a mucro, frequently replaced by a larger avicularium, with spatulate mandible. *Oœcia* subglobose, depressed, closely united to the cell above, sometimes completely immersed, punctured, often partially enveloped in a granular crust; occasionally mucronate.

Colonies spreading in subcircular patches of a bright red colour; when young surrounded by a distinct border of partially developed zoœcia.

Var. *a. ochracea* (= *Lepralia auriculata*, var. *Leontiniensis*, *Waters*). Surface of the zoarium flat, thickly covered with minute papillæ; orifice of the zoœcia suborbicular, produced below into a pointed sinus; a little below it a small oval avicularium, immersed, sometimes placed obliquely, mandible pointing downwards; often replaced by a very large, elongate avicularium, covering a great portion of the front of the cell; mandible of almost

equal width throughout, very slightly, if at all, expanded at the extremity.

Colony a large, irregular crust, of a dull-yellow colour when dead.

Var. β (*cuspidata*). With a conspicuous spike-like process on the front of the ovicell; *avicularium* very prominent. (Plate XXIX. fig. 8.)

RANGE OF VARIATION. *S. auriculata* is liable to many variations, some of which involve a remarkable change in the appearance of the species. Many of these variations are due to the different degrees of calcification which mark the different stages of growth, and which are also probably to some extent dependent on diversities in habitat. In their youngest state the cells have the walls thin and perfectly smooth, and more or less punctured. They are soon, however, enveloped in a crust composed of anastomosing ridges, amongst which the punctures are visible. This is their normal adult condition. But in some cases the thickening of this secondary envelope is carried to an extraordinary extent. The cells are buried so deeply beneath a mass of coarse reticulated crust, that the mouth and avicularium, instead of being on the surface, are placed at the bottom of a kind of circular shaft. The character of the ovicell is also much affected by the development of the calcareous covering. It is sometimes so much enveloped by it, that it appears as a very slight swelling on the surface of the zoarium. At other times it is partially inclosed by the crust, a somewhat semicircular space being left free in front. In some cases the zoarium is overspread by a white granular crust. Besides these differences, which are due to calcification in its various degrees, there are others in the form and position of the avicularium which have a special interest. In its normal condition this appendage is small and almost circular,

and is situated on the top of a mamillary swelling immediately below the inferior margin of the mouth. In other states, however, some of the mamillæ, especially towards the edge of the colony, are found of much larger size, bearing an elongated avicularium of somewhat oval shape. In others the increase in size has been carried much further, accompanied by a striking modification in the form of the avicularium, which is now distinctly spatulate. A specimen of *S. auriculata*, in which a considerable number of the cells have passed into this condition, presents a very remarkable appearance—the avicularia, with their large rounded extremities, projecting beyond the mamillary eminences on which they are mounted. In the interior of the colony cells may be found which bear the usual character.

In the var. marked *a* (*ochracea*) there is considerable divergence from the normal type. In most of the cells the avicularia, instead of being elevated and placed immediately below the mouth, are situated at some distance from it, on the front surface, and are completely immersed. They are small, and oval or subcircular in shape. Many of the cells, however, bear avicularia that may truly be called gigantic. They extend from a little below the orifice to the bottom of the cell, and are so ample as almost to cover the front surface. They have not the truly spatulate figure which distinguishes the large avicularia just mentioned, and are best described as linear-oblong. The sides are not hollowed out, nor is the extremity enlarged.

So striking are the peculiarities of this form that I at first regarded it as a distinct species, and described it under the name of *Lepralia ochracea*. I am now convinced, however, that these variations in the avicularium are not characters of specific value. On a specimen of

undoubted *S. auriculata* I have met with large avicularia exhibiting the same type of form as those just described. The short oval avicularia correspond with an early developmental stage in the normal form. The total absence of the umbo and the immersed condition of the avicularium seem to be the only really distinctive points ; and these are of comparatively small importance.

These varietal modifications of the avicularium, of which we have many instances, have a high morphological interest. They illustrate the instability of this element of the structure, to which I have elsewhere referred, and should teach us caution in employing it as a diagnostic character.

HABITAT. On shells, stone, Coralline, and occasionally weed (*Ptilota plumosa*, Finmark), from very shallow to deep water.

LOCALITIES. Widely distributed, and common. The Minch ; Shetland, to 100 fathoms (A. M. N.) : Orkney (Lieut. Thomas) : Northumberland, rare (Alder) : Norfolk (Hassall) : Suffolk ; Isle of Wight (Busk) : Isle of Man ; Devon ; Cornwall, 60 fathoms (T. H.) : Scilly (M'Andrew) : Belfast (W. T.) : Dublin (Hassall) : &c. Var. *a.* coast of Cornwall, 30 fathoms ; var. *β.* Guernsey (T. H.).

GEOGRAPHICAL DISTRIBUTION. Greenland (Torell) : Finmark (Lovén) : Spitzbergen, on Nullipores and stones, 3-30 fathoms (Smitt) : Bergen (A. M. N.) : Gulf of St. Lawrence (Dawson) : Algiers (J. Y. J.) : Ægean Sea, var. (E. Forbes) : ? E. Falkland Islands, 4-70 fathoms (Darwin) : Glenelg (T. H.). Var. *β.* ? Red Sea or Mediterranean.

RANGE IN TIME. Normal and var. *a.*, Sicilian Pliocene, Bruccoli (A. W. Waters).

SCHIZOPORELLA UMBONATA, Busk.

Plate XXIV. fig. 2.

LEPRALIA UMBONATA, *Busk*, Quart. Journ. Micr. Sc. viii. 143, pl. xxvii. fig. 1.

Zoecia oblong, serial, separated by a narrow raised line, areolated round the margin, and sometimes punctured in front, with a central umbo; orifice suborbicular or sometimes contracted below, peristome simple, armed with four spines above; immediately below the orifice a prominent *avicularium*, with a semicircular mandible. *Oecia* large, rounded, umbonate, with a small vitta or depressed area placed obliquely on each side below.

HABITAT. On stone.

LOCALITY. Shetland (Barlee).

Mr. Busk compares this form with *Lepralia verrucosa*. Of its affinities I can only speak doubtfully, as it is one of the few species which I have not had the opportunity of examining; but in general character it certainly approaches very nearly to *S. auriculata*; and as it is stated that the orifice is sometimes contracted below, we may, I think, infer that its closest relationship is with the present group. The umbo in the centre of the cell, and the vittæ on the oecium are the most characteristic features. In most other respects, in the shape and disposition of the cells, in the general form of the orifice, in the number of the spines and the position of the avicularia, it agrees with the preceding species.

The umbo on the ovicell, as Mr. Busk has remarked, "is merely that belonging to the cell in front of which the ovicell rises."

SCHIZOPORELLA DISCOIDEA, Busk.

Plate XXX. figs. 8, 9.

- LEPRALIA DISCOIDEA, *Busk*, Quart. Journ. Micr. Sc., Zoophytol. vii. (1859), 66, pl. xxii. figs. 7, 8; *ibid.* viii. 144, pl. xxvii. figs. 4, 5; *ibid.* viii. 283: *Hincks*, Quart. Journ. Micr. Sc., Zoophytol. viii. 276, pl. xxx. figs. 4, 4 a.
- ALYSIDOTA CONFERTA, *Busk*, Rep. Brit. Assoc.

Zoæcia ovate, punctured or granular, surrounded by a raised line, disposed in linear series, which radiate regularly from a central depression; orifice slightly raised, arched above, lower margin straight, with a notch in the centre; peristome, in fertile cells, much elevated in front; oral spines 6-7; on one side (or on both sides), a little below the mouth, a small raised, oval *avicularium*, mandible directed downwards; frequently replaced in the marginal cells by a long linear *avicularium* slanting outwards. *Oæcia* globose, recumbent, punctured, hooded.

Colonies small, forming subcircular patches, slightly depressed in the centre.

RANGE OF VARIATION. The surface of the cells, which is smooth and punctured in an early condition, becomes more calcified with age, and the punctures are surrounded by roughened ridges of stony matter; in a more advanced stage the walls are much thickened and granular. The chief variations occur in the number, shape, and distribution of the *avicularia*. The elongated form is almost confined to the young or marginal cells, and is by no means always present upon them. It usually occurs in pairs, one on each side of the mouth. Occasionally, but very rarely, it is met with on one of the inner cells. In most cases it is replaced by a small raised *avicularium*, situated a little below the mouth, sometimes on both sides,

sometimes on one side only, and frequently in the centre. Specimens seem to occur in which these appendages are wanting altogether.

HABITAT. On shells from moderate depths.

LOCALITIES. Shetland (Barlee): coast of Antrim (Hyndman): Hastings (Miss Jelly): Guernsey (T. H.): Birterbuy Bay (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Madeira; Algiers (J. Y. J.).

This eminently characteristic species is readily distinguished from all other British forms. It grows in somewhat circular patches, slightly depressed at the centre, where the cells are much smaller than elsewhere. From this point well-marked rows of cells radiate with perfect regularity towards the margin. A very peculiar appearance is given to the colony by the hooded ovicells, which are produced in great profusion. The peristome rises to a considerable height in the fertile cell, projecting in front, and united at the sides to the ovicell, so as to form a wall round the mouth, which conceals the real opening. In some cases it is extended as an arch across the front of the ovicell itself. In fresh specimens the cells are distinctly defined by a raised marginal line. The long, dependent avicularia are frequently wanting.

c. Usually without avicularia.

SCHIZOPORELLA SINUOSA, Busk.

Plate XLII. figs. 1-6.

LEPRALIA SINUOSA, Busk, Quart. Journ. Micr. Sc. viii. (1860), 125, pl. xxiv. figs. 2, 3.

ESCHARELLA LINEARIS, forma SECUNDARIA, Smitt. Œfvs. K. Vetensk.-Ak. Forh. 1867, Bihang, 14 and 99, pl. xxv. figs. 74-77.

Zoecia subrhomboidal or irregularly ovate, flattened in front, slightly elevated towards the orifice, bounded by a prominent sinuous line; surface granular, large foramina round the base of the cell, and frequently scattered over the entire surface; orifice, in its earliest stage, arched above, lower margin straight, with a rounded sinus in the centre, peristome thin, unarmed; at a more advanced stage suborbicular, produced below, peristome raised. *Oaecia* rounded, depressed, subimmersed, granular, frequently with a single large pore on the front.

Colonies forming subcircular, flat, glossy crusts, of a rich red colour.

Var. *a* (*armata*). With a small *avicularium* within the mouth on the lower margin; mandible rounded (Plate XLII. fig. 2).

RANGE OF VARIATION. This species exhibits some very remarkable variations, dependent chiefly on the extent to which calcification has proceeded. The mouth completely changes its character at different stages of growth, the primitive shape being more or less concealed by a secondary formation, which surrounds and partially overhangs the original aperture. As it appears in young colonies or in marginal cells, the mouth is almost semicircular, with a straight lower margin, which is hollowed in the centre into a rather broad rounded sinus. The secondary aperture, which is found in the older portions of the colony, and which closes in the original opening, is suborbicular, more or less produced and pointed below. The latter character varies considerably; and, especially towards the edge of the crust, the lower secondary margin is often without the sinus.

The surface is usually granular, covered with minute wart-like prominences. The large foramina are sometimes confined to the border of the cell, but very frequently they are scattered over the surface. They are filled in by a

membrane, and appear as glittering spots of a pale golden colour. With age the walls thicken and the foramina are sometimes obliterated, the surface being uniformly granular. In a variety from Shetland the front wall of the cells is almost smooth and glossy, and covered by a network formed by a delicate beaded line (Plate XLII. fig. 4). When old and worn the red tint is lost, the walls are much thickened, and of a dirty whitish colour, and coarsely punctured. Postpliocene examples from Canada present exactly this appearance, and hardly differ, except in the larger size of the cells, from old specimens dredged in Scotland.

Smitt has remarked that a small avicularium is sometimes present on the lower margin, between the primary and secondary apertures. On British specimens I have never seen any trace of such a structure; but on a form from the Gulf of St. Lawrence, which in all other respects (except, perhaps, the size of the cells) agrees with *S. sinuosa*, an avicularium with a rounded mandible occurs, occupying much the same position as in *Porella concinna*. I have described this form as var. *α* (*armata*).

The central pore on the front of the ovicell frequently shares the fate of the foramina in the cell-wall, and is obliterated by the calcareous overgrowth.

HABITAT. On shells and stones from shallow to deep water (150 fathoms).

LOCALITIES. Shetland (Barlee): *ibid.*, on stone and shell, Outer Haaf (A. M. N.): west coast of Scotland (T. H.).

GEOGRAPHICAL DISTRIBUTION. Spitzbergen, 30–50 fathoms; Finmark, frequent (Smitt): Greenland (North-Germ. Pol. Exped.): lat. $72^{\circ} 55' N.$, long. $37^{\circ} 57' 68'' E.$, 150 fathoms (Dutch Arctic Exped. 1878): Gulf of St. Lawrence, normal and var. *α* (Dawson).

RANGE IN TIME. Canadian Postpliocene deposits (Dawson).

SCHIZOPORELLA CECILII, Audouin.

Plate XLIII. fig. 6.

FLUSTRA CECILII, *Aud.* Expl. i. 239 : *Savigny*, Egypte, pl. viii. fig. 3*.LEPRALIA CECILII, *Busk*, Quart. Journ. Micr. Sc., Zoophyt. v. 173, pl. xv. figs. 6, 7 : *Hincks*, Devon and Cornw. Cat., Ann. N. H. ser. 3, ix. 205 (45 sep.).?LEPRALIA PERUGIANA, *Heller*, Bryoz. Ad. M. 26, pl. ii. fig. 10.

Zoæcia ovate, distinct, separated by moderately deep sutures, lined round, quincuncial, thickly punctured over the surface, with a smooth central umbo; orifice arched above, lower margin straight, with a loop-like sinus in the middle; peristome slightly thickened. *Oæcia* globose, prominent, minutely granular, of a delicate pearl-whiteness. *Avicularia* none.

Colonies spreading irregularly, vitreous and glistening when fresh.

RANGE OF VARIATION. There is very little variability in this handsome species; but it seems to be very liable to monstrosities. The ovicells are commonly distorted and bent out of their natural position. Abnormal cells also frequently occur, of great width and irregular shape, formed evidently by the union of two cells.

HABITAT. On stone, shell, &c. from rather deep water.

LOCALITIES. Jersey (Mrs. Buckland) : coast of Cornwall, on stone, &c., from deep water; Guernsey (T. H.).

GEOGRAPHICAL DISTRIBUTION. Algiers (J. Y. J.): ? Adriatic (Heller) : Naples (A. W. Waters) : Australia (Miss Jelly).

* *Savigny's* figure is admirable in most respects; but the artist has represented a granular instead of a punctured surface.

SCHIZOPORELLA CRUENTA, Norman.

Plate XXX. fig. 5.

LEPRALIA VIOLACEA, var. CRUENTA, *Busk*, B.M. Cat. ii. 69, pl. cx. fig. 1.LEPRALIA CRUENTA, *Norman*, Ann. N. H. for Jan. 1864, 7.DISCOPORA CRUENTA, *Smitt*, Öfv. Kong. Vetensk.-Akad. Förh. 1878, No. 3, 23.

Zoæcia ovate, often irregular in outline; walls massive, the surface undulated, coarsely granular, perforated in front by a number of large foramina, and also more or less punctured round the edge; orifice suborbicular, closed in by a thick rounded border, which is slightly channelled in front. *Oæcia* unknown.

Colonies in small, roundish or irregular patches of a deep-red colour.

HABITAT. Usually on large stones from deep water; more rarely on shells.

LOCALITIES. Shetland, rare, 80–100 fathoms (A. M. N.): Peterhead, rare (C. W. P.): Orkney (Dr. Greville): Channel Islands (Busk).

GEOGRAPHICAL DISTRIBUTION. Nova Zembla, Beluscha Bay, 30–50 fathoms (Stuxberg and Théel, *vide* Smitt); Greenland ('Valorous' dredgings).

RANGE IN TIME. Scotch Glacial deposits (Geikie).

Distinguished by its massive habit, its rugged surface pierced by numerous large punctures, and its rich red colour. The typical form of the cell is ovate; but there are many irregularities. The surface of the zoarium is covered with inequalities, pierced by many holes, and roughened throughout by a multitude of granules. Round the mouth the thick walls swell out into a broad massive border and close it in. There is no armature whatever, but the greatest structural simplicity. The

rich colour, which is tolerably preserved in dead specimens, is a good specific mark.

The orifice in young cells is slightly sinuated in front; and this character allies the species to the present group; but it is singularly destitute of striking structural features.

SCHIZOPORELLA HYALINA, Linnæus.

Plate XVIII. figs. 8-10.

CELLEPORA HYALINA, *Linn. Syst. ed. 12, 1286: Fabr. Faun. Grœnl. 435.*

CELLEPORA NITIDA, *Fabr. Faun. Grœnl. 435.*

CELLEPORA PERSONATA, *D. Chiaje, Ann. S. Vert., Mem. iii. 39, pl. xxxiv. figs. 17, 18 (ovicell).*

ESCHARINA PERSONATA, *M.-Edwards, in Lamk. An. s. V. ed. 2, ii. 236, no. 24.*

BERENICEA HYALINA, *Hass. Ann. N. H. vii. 367.*

LEPRALIA CYLINDRICA, *Hass. Ann. N. H. vii. 368, pl. ix. fig. 6 (opaque var.).*

LEPRALIA HYALINA, *W. Thompson, Ann. N. H. v. 253: Johnston, B. Z. ed. 2, 301, pl. liv. fig. 1: Busk, B.M. Cat. ii. 84, pl. lxxxii. figs. 1-3, pl. xcv. figs. 3-5, pl. ci. figs. 1, 2.*

?CELLEPORA OVOIDEA, *Lamx. Pol. Corall. flex. 89, pl. i. fig. 1; Exp. Méth. 2, pl. lxiv. figs. 4, 5.*

CELLEPORELLA HYALINA, *Gray, B.M. Rad. 128.*

MOLLIA HYALINA, forma HYALINA auctt., *Smitt, loc. cit., Krit. Fört. iv. 16 and 109, pl. xxv. figs. 84, 85.*

Zoæcia elongate-ovate or subcylindrical, horizontal, distinct, occasionally subcarinate, disposed somewhat irregularly in radiating rows often separated by punctured spaces; walls very thin and hyaline; surface smooth and shining, or slightly furrowed transversely; orifice terminal, orbicular, frequently with a deep sinus in front; peristome thin, the upper margin raised. *Oæcia* globose, prominent, punctured, often rising into a boss in front; fertile cells small and partially aborted, produced chiefly in the central portions of the colony, and developed upon the primitive layer of cells.

Polypide with 12 tentacles.

Colonies forming white circular patches, often with a silvery lustre.

Var. α (*cornuta*). With a stout tubular process on each side of the mouth.

Var. β (*incrassata*). Walls thickened and opaque.

Var. γ (*tuberculata*). With a number of tubercles on the front of the cell, and often a strongly developed umbo below the orifice*.

RANGE OF VARIATION. In what may be regarded as its normal condition, the cells of *S. hyalina* are glassy and transparent, of thin substance, and most delicate texture.

A variety, however, is of common occurrence in which the walls are much thicker, opaque, and of a dirty white colour. The cells, except those which carry the ovicells, are usually subcylindrical, elongated, and very slightly bulging at the sides, but occasionally of a shorter and broader make. In some cases the cell-wall slopes rather steeply up on each side towards a central keel, which passes from the orifice, where it rises into a prominent point, to the base of the cell. A ridge-like umbo is also frequently developed immediately below the inferior margin. The orifice presents itself in two very different conditions: in one it is ample and simply orbicular; in the other there is a marked sinus on the lower margin, which is sometimes broad and open and sometimes very

* Busk, in a paper on new Species of Polyzoa from Kerguelen's Island (Ann. N. H. for Feb. 1876, p. 116), describes a variety *conferta*, distinguished by "the crowded and confused growth of cells and ovicells in the central portion of the patch," giving it the appearance of a *Cellepora*, and by the wide, patulous mouth. But the first of these characters has certainly no claim to be regarded as varietal. It belongs to the ordinary form of the species, and is one of its most striking features. It is associated with the wide, patulous, orbicular mouth, and also with the smaller sinuated aperture.

deep and narrow. The extreme forms (the simply orbicular and that with a subtubular sinus) are connected by intermediate varieties. In many cases the two projections or denticles, placed one on each side of the aperture a little above the inferior margin, which mark the position of the hinge of the oral valve, are quite inconspicuous, and the mouth appears almost perfectly circular. In other cases they are more strongly developed, and stand out so prominently as to produce a decided narrowing of the aperture, while, at the same time, they define a broad and shallow sinus below. In this condition there is only a slight departure from the orbicular type; but a further change in the same direction brings with it the contraction and deepening of the sinus, and affects materially the contour of the mouth.

A common variety (*cornuta*) (Plate XLV. fig. 2) has two erect processes, rising one on each side of the orifice. But perhaps the most remarkable deviation from the ordinary type is met with in an Australian form, which, in spite of its peculiarities, must be referred to this species. On each side of the orifice, which is furnished with a deep and narrow sinus, is a process such as we find in the variety *cornuta*. Immediately below the inferior margin rises a very tall mucro, broad at the base, and tapering upwards, which usually bends inward over the mouth. A line of prominent tubercles runs down each side of the cell on the front wall; and frequently one is also present in the centre. The ovicell is developed on the ordinary zoëcia, is flattened in front, with a number of tubercles round the edge, and an umbo in the middle. Notwithstanding the extraordinary development of tubercular processes in this form, it agrees so fully in essential characters with *S. hyalina*, that it is properly ranked as a variety.

Not unfrequently the interstitial spaces between the lines of cells are punctured, the perforations being narrow and elongate. Small tubules are also sometimes present in the same situation, which I believe to be the rudimentary stage of the dwarf cells that bear the oœcia, and of the other secondary cells associated with them.

In a variety from Santa Cruz the cells are much produced and attenuated below, with massive transverse ridges, one of which projects immediately beneath the mouth; the interstices are strongly punctured. (Plate XLV. fig. 3.)

HABITAT. On shells, stones, *Laminaria saccharina* and other Algæ, stems of Sertulariida, &c., from between tide-marks to deep water (between 62 and 72 fathoms, coast of Antrim; 100 fathoms, Greenland).

LOCALITIES. Universally distributed on the coasts of Great Britain and Ireland.

GEOGRAPHICAL DISTRIBUTION. Cosmopolitan. Australia (vars. *cornuta* and *tuberculata*); New Zealand (T. H.): East Falkland Islands, 4–10 fathoms (Darwin): Cape of Good Hope (Harvey): Kerguelen's Island, three vars. (Busk): Natal, var. *cornuta* (W. Oates): California, normal and var. *cornuta* (Dr. Sinclair): Anticosti and Mingan Islands (Packard): Bahusia to Spitzbergen and Greenland, 3–30 fathoms (Smitt): Davis Strait, off Frederickshaab, 100 fathoms (Wallich): Nova Zembla, 2–20 fathoms (Stuxberg and Théel): off Bear Island (Dutch Arctic Exped.): Roscoff, on red Algæ and *Chondrus* (Joliet): France, S.W. (Fischer): Santa Cruz, var. (Miss Jelly).

RANGE IN TIME. Cor. Crag, Sutton, on shell (S. W.): Red Crag (A. Bell): Scotch Glacial deposits (Geikie): Postpliocene deposits, Canada (Dawson).

The most interesting point in the history of this common and widely spread species is the mode in which the ovicelligerous cells are developed. Universally, it would seem, in the common form, the ovicells are produced, not on the primary perfect zoëcia, but on special rudimentary cells, which originate on the upper surface of the former, and are intercalated between them, at the oral extremity.

These ovicelligerous cells are wedge-shaped, and of very small size, and fit into the space that separates the zoëcia at their upper end. They are aggregated in the central portion of the colony, where they occur in great numbers, and give the crowded and "heaped" appearance so characteristic of the species in its adult condition. Amongst the ovicelligerous cells there are usually many cells of normal form, but small size, frequently extremely diminutive, developed, like the former, upon the primitive layer, and constituting an upper stratum. As I have said, the mass of ovicelligerous and other secondary cells is confined to the centre of the colony; and surrounding it there is generally a broad tract occupied by the subcylindrical cells, lying horizontally and regularly disposed, and forming a glittering belt round the opaque central nucleus*.

The ovicelligerous cells of *S. hyalina* derive an additional interest from the close resemblance which they bear to the curious structures that frequently occur on the front of the zoëcia in *S. linearis*. The chief difference between them lies in the more rudimentary condition of the cell in the latter.

* "Limbum quasi radiatum faciunt."—OTHO FABRICIUS.

d. *Avicularia* on a distinct area above the cell.

SCHIZOPORELLA VENUSTA, Norman.

Plate XXX. figs. 6, 7.

LEPRALIA VENUSTA, *Norman*, Ann. N. H. January 1864, 84, pl. x. figs. 2, 3.

GEMELLIPORA GLABRA, forma STRIATULA, *Smitt*, Flor. Bryoz. pt. ii. 37, pl. xi. fig. 207.

Zoæcia lozenge-shaped, occasionally ovate, moderately convex, irregularly disposed, with a prominent umbo below the mouth; surface smooth and hyaline, punctured; orifice orbicular above, produced below into a wide, shallow sinus, immediately above which are two small lateral sinuses, placed one on each side; above each cell a small rectangular area, with a minute avicularium near the top of it, mandible rounded. *Oæcia* rounded, somewhat depressed, punctured, surmounted by a very small avicularium.

HABITAT. On shells, in shallow water; on Nullipore, from a greater depth.

LOCALITY. Off Guernsey, in about 10 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Florida, 68 fathoms (Pourtales).

This is a very elegant species. The cells in their young and fresh condition are smooth, hyaline, and glittering, prettily speckled with a multitude of minute puncta. In some cases, however, they soon lose this beauty, and are covered by a dull whitish crust, which partially conceals the perforations, and gives the zoarium a coarse appearance. I have seen the whole of the central portion of a colony in this condition, but surrounded by a bright zone of semi-transparent cells.

The zoëcia are comparatively short in the older portions of the colony, and more elongated towards the margin. The shape of the orifice is very peculiar and distinctive: the portion above the hinge of the oral valve is round; but at this point there is a slight constriction, caused by two small lateral projections; immediately below them the margin recedes, and two minute indentations are formed, and the aperture then narrows away into a shallow and somewhat pointed sinus. The whole orifice has an elongated appearance, and tapers off downwards, the regularity of its outline being broken by the lateral sinuses.

The central umbo is of large size, and seems to be generally present. Above the cells there is a small rectangular space, marked off like the ordinary zoëcia, and, like them, with a punctured surface, but having a minute avicularium near the top of it in the place that would be occupied in a normal cell by the oral aperture. When the ovicell is present, it covers a large portion of this avicularian cell, but the avicularium itself projects beyond it and is visible on the summit.

I have met with a considerable group of these modified cells, of various sizes and shapes, in the midst of a colony, and on one or two of them the umbo was present in the usual position (Plate XXX. fig. 7). They afford one more striking illustration of the morphological relation between the avicularium and the zoëcium.

The remarkable structure of the orifice of the cell in the present form seems at first sight to separate it in a very decisive way from the allied species. But it must be remembered that we have the same peculiarity, though in a much less marked degree, in *S. sanguinea*, a species which in general character agrees very closely with *S. linearis*. In what seems to be a variety of the latter, I have noticed an approach to the same condition; whilst in

Mastigophora Hyndmanni the lateral sinuses are in some states very apparent, and in others almost disappear. In all cases this peculiarity in the form of the orifice is due to the degree in which it is constricted near the hinge of the operculum, and is a mere matter of detail, and not a change of type. In *S. venusta* the variation seems more striking, from the orbicular form of the orifice above and the great width of the sinus. I do not think that we can isolate this species from the present genus.

Lepralia obvia, described by Manzoni from the Pliocene of Castrocara, agrees with *S. venusta* in the form of the mouth.

Genus MASTIGOPHORA, *Hincks*.

Der. From μάστιξ, a whip, and φέρω, to bear.

FLUSTRA (part.), Audouin.

LEPRALIA (part.), auctt.

HERENTIA (part.), Gray.

HIPPOTHOA (part.), Smitt.

GENERIC CHARACTER.—ZOECEIA *with a semicircular orifice, the inferior margin straight, with a central sinus; furnished with lateral vibracula.* ZOARIUM (*in British species*) *incrusting.*

THE presence of fully developed vibracula in place of the more usual avicularian appendages distinguishes the present genus from the preceding. The character seems to be one of considerable importance, both morphologically and physiologically, and may fairly be used, I think, to mark off a separate group.

MASTIGOPHORA DUTERTREI, Audouin.

Plate XXXVII. figs. 1, 2.

FLUSTRA DUTERTREI, Audouin, Expl. ; Savigny, Égypte, pl. ix. fig. 2.

LEPRALIA WOODIANA, Busk, Crag Pol. 42, pl. vii. figs. 1 & 3; Quart. Journ. Micr. Sc., Zooph. viii. 284: Hincks, Quart. Journ. Micr. Sc. viii. 276.

LEPRALIA AURITA, Reuss, Bryoz. d. deutsch. Septarienth. 62, pl. vii. fig. 13.

LEPRALIA OTOPHORA, Manzoni, Bryoz. di Castrocaro, 23, pl. iii. figs. 30 (not *L. otophora*, Reuss).

Zoœcia ovate or rhomboid, distinct, usually punctured round the margin; surface granulated, the granules frequently in radiating lines; orifice arched above, inferior margin straight, with a slit in the middle, occasionally an umbo below it; peristome sometimes raised and thickened in the fertile cells, and forming a wall round the mouth; marginal spines five or six; on each side of the orifice, near the top of the cell, a slender vibraculum of moderate length. *Oœcia* globose, closely adnate to the cell above, often subimmersed, sometimes with one or two spines in front of them on each side.

Colonies forming rather large crusts, with a tendency to a lobate mode of growth.

RANGE OF VARIATION. There are two very marked forms included under this species. In one (*a*), which is common in Shetland, the cells are of a greyish colour and somewhat silvery, and the granules covering the surface are disposed pretty regularly in lines which radiate from the centre towards the margin. The row of large pores round the base is wanting; and the peristome in the fertile cells is not raised and thickened in front; occasionally there is a slight prominence beneath the lower margin. The vibracula are rather small. This variety is much more delicate than the following. In the other (*β*) the surface is uniformly granular, and there is usually no

endency to radiation, the marginal punctures are a conspicuous feature, and the peristome is greatly developed, especially in the fertile cells, in which it forms a wall round the orifice. There is no trace, however, of the broad and prominent umbo with a cup-like cavity above it, which, according to Busk, distinguishes the Crag representatives of the species. This second form has occurred on the coasts of Antrim and Cornwall*.

The first of these varieties seems to agree very closely with the *Flustra Dutertrei* of Audouin. The Crag form agrees generally with the Antrim and Cornish specimens; and with these may be ranked the Tertiary *Lepralia aurita* of Reuss.

I see no sufficient reason for separating these varieties specifically, though they certainly present a very different appearance; and I have therefore restored Audouin's name. A Madeiran form, mentioned by Busk, seems to combine some of the peculiarities of each†; and I have a specimen from Antrim in which there is a curious blending of the characters of the two varieties. It has the elevated peristome in the fertile cells and the flat surface which distinguish the form β ; but there is a decided tendency towards the radiate arrangement of the granules, whilst in one half of the colony the marginal punctures are a conspicuous feature, and in the other are altogether wanting.

The *Hippothoa pes-anseris* of Smitt, from the Gulf of Florida, seems to differ from the present species in a single character only—the remarkable shape of the vibraculum, which curiously imitates the webbed foot of a bird.

HABITAT. On shells and stone, from deep water.

* The specimens from these localities stand alone in having the peristome elevated into a wall round the mouth in front of the oœcium. The cells are also somewhat more depressed than in the Shetland variety.

† Quart. Journ. Microsc. Sc. viii. p. 284.

LOCALITIES. Form α :—Coast of Antrim (Hyndman) : off the Deadman, coast of Cornwall, 60 fathoms (T. H.). Form β :—Shetland, very abundant, 80–170 fathoms (A. M. N.) : Guernsey (T. H.).

GEOGRAPHICAL DISTRIBUTION. Red Sea (Savigny) : Madeira (J. Y. J.).

DISTRIBUTION IN TIME. Coralline Crag, on *Tellina* (Searles Wood) : Mitteloligocän Tertiary beds, at Söllingen (Reuss) : Older Pliocene, Castrocaro (Manzoni).

MASTIGOPHORA HYNDMANNI, Johnston.

Plate XXXVII. figs. 3–6.

LEPRALIA HYNDMANNI, *Johnst. B. Z.* ed. 2, 306, pl. liv. fig. 6 : *Busk*, B.M.

Cat. ii, 74, pl. lxxxvii. figs. 5–8.

HERENTIA HYNDMANNI, *Gray*, B.M. Rad. 122.

HIPPOTHOA POROSA, *Smitt*, Floridan Bryozoa, pt. ii. 41, pl. vii. fig. 158.

Zoæcia ovate or rhomboid, broad, flat, smooth, and often with a row of punctures round the edge, or coarsely punctate over the entire surface, bordered by a raised line; orifice arched above, straight below, slightly notched at each side above the inferior margin, and with a central sinus; peristome forming a broad, thickened border round the upper part of the orifice; a long *vibraculum*, springing from a distinct vibracular cell, on one side, a little below the mouth. *Oæcia* small, arcuate, flattened in front.

Colonies forming small, flat, inconspicuous patches.

RANGE OF VARIATION. *M. Hyndmanni* exhibits a very interesting series of varieties, embracing forms which, in the hands of some systematists, would probably obtain specific rank. Indeed Smitt has separated one of them,

and by no means the most marked, under the name of *Hippothoa porosa*.

The cells in our British specimens usually present a very flat surface, and are rhomboid in figure; the walls are of dense texture; and the border is perforated by a single row of pores. In some cases, however, the shape varies to ovate, the surface is convex, and the marginal perforations are wanting. The vibraculum also varies much in length. In a form from the Red Sea (?) the species wears a very different aspect. The cells are nearly half as large again as in British specimens, ovate and very convex, and a good deal narrowed above; the thickened peristome surrounds the whole orifice, instead of being confined to the upper part of it; the entire surface is covered with coarse punctures; and the vibracula, which are slender and whip-like, attain an enormous development. The vibracular cell is also placed much nearer to the orifice than is usual. This is probably the *porosa* of Smitt (Plate XXXVII. fig. 5). In a yet more remarkable form from South Africa the shape of the orifice has undergone modification, and the central sinus has disappeared; the ovate cells, which do not exceed in size those of our British form, are covered with puncta; and a little below the inferior margin of the mouth there is a small circular pore. Perhaps the most remarkable change has taken place in the vibracula, which, instead of being slender and thread-like, present a rigid appearance, are of moderate length, broad below, and tapering gradually to a point, and bear no slight resemblance to a miniature sword or scimitar. This very marked form is worthy of being recorded as *M. Hyndmanni*, var. *ensiformis*, if it is not entitled to specific rank (Plate XXXVII. fig. 6).

HABITAT. On stones, shells, &c., from deep water.

LOCALITY. Sana Island, off the south-east of the Mull

of Cantire, 40 fathoms ; off the coast of Antrim, abundant (Hyndman) : Belfast Bay (W. T.) : Beaufort Dyke, west coast of Scotland, 110–145 fathoms (Capt. Beechey) : Shetland, 80–110 fathoms ; Hebrides (A. M. N.) : Peterhead, a single specimen (C. W. P.). This species has a very limited range in our seas, being almost confined to the western coasts and Shetland so far as our present knowledge goes.

GEOGRAPHICAL DISTRIBUTION. Madeira (J. Y. J.) : South Africa, var. *ensiformis* (Miss Jelly) : off the coast of Florida, var. *porosa* (Pourtales) : ?Red Sea (R. S. Newall).

Genus SCHIZOTHECA, *Hincks*.

Der. From $\sigma\chi\acute{\iota}\omega$, to divide, and $\theta\acute{\eta}\kappa\eta$, a receptacle.

LEPRALIA (part.), auctt.

SCHIZOTHECA, Hincks, Ann. N. H. Dec. 1877.

GENERIC CHARACTER.—ZOECIA *with a suborbicular primary orifice, the lower margin sinuated ; the secondary orifice raised, tubular, notched in front. OECIUM terminal, with a fissure in the front wall. ZOARIUM (in British species) adnate.*

THIS genus agrees with the rest of the Myrionozoidæ in having a sinus on the lower lip of the primary opening ; but in the adult cell this character is completely concealed by the growth of an elevated, tubular, secondary orifice, which in the British species is more or less notched in front, and carries a number of very tall marginal spines. There is a total absence of the punctures in the cell-wall, which are so general amongst the *Schizoporellæ* ; and the ovicell exhibits a peculiarity in its fissured front surface which is only met with elsewhere amongst the *Reteporæ*.

SCHIZOTHECA FISSA, Busk.

Plate XLI. figs. 1-3.

LEPRALIA FISSA, *Busk*, Quart. Journ. Micr. Sc., Zoophytol. iv. 308, 309, pl. ix. figs. 8, 9, 10.

Zoæcia lozenge-shaped, smooth and glassy, disposed in regular linear series, divided by deep furrows, and radiating from a common centre; orifice orbicular, much raised, tubular, with a deep notch on the lower margin; oral spines six, long and slender; *avicularia* large, with a pointed mandible, generally directed outwards, placed at the upper end of a distinct area, distributed irregularly over the colony. *Oæcia* globose, prominent, smooth or slightly roughened, with a large, wedge-shaped fissure in front; two spines visible in front on each side.

Colonies forming small silvery-white patches.

RANGE OF VARIATION. The avicularia are usually to be met with near the margin of the colony, where they often alternate with the ordinary cells. Sometimes they are ranged in a line, with perfect regularity, amongst the latter; not unfrequently there is a large collection of them at a certain point, whilst few are found in other parts of the colony. In some cases they are scattered irregularly in the interstitial spaces. They are of large size, with a long, pointed mandible, which falls upon a well-developed "beak," and are placed at the upper end of a distinct, lozenge-shaped area, which in size and general appearance corresponds with the normal cell. Apart from these differences in the number and position of the avicularia, this is a very constant species.

In the earlier stages of growth, the cell is destitute of its tubular peristome, and is slightly sinuated on the lower margin. When old there is a remarkable change in the appearance of the zoarium, the walls becoming thick,

coarse and granulous, and losing altogether their vitreous character and their lustre, whilst the very characteristic spines are usually wanting. At first sight the species is hardly recognizable in this condition.

HABITAT. On shells, stones, &c., from moderate depths.

LOCALITIES. Coast of Devon (Miss Cutler): Exmouth (Barlee): off the Deadman, Cornwall, 30-40 fathoms; Birterbuy Bay (T. H.): Guernsey, where it is abundant (Alder): coast of Antrim (Hyndman).

GEOGRAPHICAL DISTRIBUTION. Naples (A. W. Waters).

Mr. Busk describes "two or three unequal teeth" as occurring on either side of the mouth; but I believe that these are nothing more than the stumps of some of the spines which are set very far forward, so as to project in front of the ovicell. The whole number of the spines is six.

SCHIZOTHECA DIVISA, Norman.

Plate XLI, figs. 4-6.

LEPRALIA DIVISA, *Norman*, Ann. N. H. Jan. 1864, 86, pl. x. fig. 6.

Zoæcia small, crowded, slightly convex, smooth, disposed in regular lines; orifice orbicular, raised, tubular, with six very long and slender spines above, a slight notch and two or three minute denticles on the lower margin, which is much swollen, and sometimes produced into a large spatulate process or flattened umbo. *Oæcia* semielliptical, much elevated, smooth, flattened in front, and with a narrow, slit-like fissure, which is not open below.

Colonies of a glossy white colour when fresh.

HABITAT. On dead shells, in moderate depths and in deeper water.

LOCALITIES. Between Guernsey and Herm (A. M. N.) : coast of Antrim, on shell (Hyndman).

There is always a swelling below the orifice ; and not unfrequently this is developed into a massive spatulate process, which gives a very grotesque appearance to the cell. There seem to be generally two or three raised points within the front margin, and, I think, a minute central notch. The fissure on the ovicell is narrow and linear, extending to within a short distance of the lower margin. The mouth of the cell is armed with six very tall and slender spines, of which two are visible below the ovicell. A marked characteristic of this species, as of the allied *S. fissa*, is the very regular disposition of the cells in linear series. Between the two forms there are many points of resemblance and affinity ; but the last-named is at once distinguished by the more elongate cell, the deeply-cut sinus on the lower (secondary) margin, and the wedge-shaped fissure in the ovicell.

Genus HIPPOTHOA, *Lamouroux*.

Der. From 'Ἰπποθόη, one of the Nereids.

CATENICELLA (part.), Blainville.

?TEREBRIPORA, D'Orbigny*.

TUBULIPORA (sp.), Jameson.

MOLLIA (part.), Smitt.

GENERIC CHARACTER.—ZOECIA *distant, caudate, connected with one another by a slender prolongation of the lower extremity, so as to form linear series ; branches given off from the sides of the cells ; orifice subterminal, sub-*

* The members of this genus burrow in the shells of certain Mollusks ; but structurally they seem to agree with the present group. Our common *H. divaricata* erodes to some extent the surface to which it is attached ; and the position of its cells, after their removal, is often marked by a very distinct depression.

orbicular, with the lower margin sinuated or produced.
ZOARIUM adherent.

SMITT disallows the genus *Hippothoa*, and ranks its members with species which are supposed to possess similar zoœcia, irrespective of the habit of growth. Thus *H. divaricata* is regarded as a *hippotoiform* variation upon *Schizoporella hyalina*. In certain varieties of the latter species the cell is attenuated and produced below, and no doubt in this condition bears a considerable resemblance to a somewhat gigantic *Hippothoa*. On the other hand, the connecting fibre is sometimes much abbreviated in the latter genus, and occasionally is quite rudimentary. In such cases we may find indications of the way in which one type has passed into the other. But as I should not place *S. hyalina* on the strength of this occasional variation amongst the *Hippothoæ*, so I should not merge the latter in *Schizoporella* because at times the caudate prolongation of the cell is almost wanting.

In several of the massive species we meet with varieties or states in which the cells run out into single linear series; but this deviation from the normal condition does not convert them into *Hippothoæ*. In such cases the cells do not usually become caudate, much less are they furnished with the thread-like appendage which is the common and typical characteristic of the latter group. These linear varieties cannot be correctly designated *hippotooid*.

Universally, I believe, amongst the *Hippothoæ* the cell is narrowed below into a kind of tubular peduncle, more or less extended; prevailing it is distinctly caudate, and produced into a filiform appendage, while the remarkable plan of the gemmation is constant. I think we have here the characters of a natural group, sufficiently (though of course not absolutely) isolated, and worthy of a separate

place and name. I have therefore decided, with the greatest respect for Profesor Smitt's opinion, to retain the genus *Hippothoa*, which has not only a strongly marked facies but also an ancient pedigree. In the Cretaceous beds it is well represented by characteristic species; and it is widely distributed in the waters of our own epoch.

HIPPOTHOA DIVARICATA, Lamouroux.

Plate XLIV. figs. 1-4; and Plate I. fig. 2.

HIPPOTHOA DIVARICATA, *Lamx.* Expos. Méth. 82, pl. lxxx. figs. 15, 16: *Johnst. B. Z.* ed. 2, 291, pl. li. figs. 3, 4: *Busk*, B.M. Cat. i. 30, pl. xviii. figs. 3, 4*.

CATENICELLA DIVARICATA, *Blainv.* Actinol. 462.

? HIPPOTHOA LANCEOLATA, *Gray*, Zool. Misc. 35: *Hassall*, Ann. N. H. vii. 366, pl. viii. figs. 5, 6: *Couch*, Corn. Faun. iii. 102, pl. xviii. fig. 6.

HIPPOTHOA PATAGONICA, *Busk*, B.M. Cat. pt. i. 30, pl. xvii. fig. 1; *id.* Crag. Pol. 24, pl. i. fig. 5.

MOLLIA HYALINA, forma DIVARICATA, *Smitt*, Cefv. K. Vetensk.-Akad. Förhandl. 1867, Bihang, 17 and 112, pl. xxv. figs. 86, 87.

HIPPOTHOA LONGICAUDA, *Fischer* (= *H. Patagonica*, *Busk*, Crag Pol.), Bryozoaires d. côtes du sud-ouest de la France, Actes Soc. Linn. d. Bordeaux, xxvii. 1870 (p. 21, sep.).

Zoæcia more or less remote, ovate or pyriform, smooth or finely striated transversely, glossy, of a pearly whiteness, carinated in front; orifice arched above, with a notch in the lower margin. *Oæcia* small, globose, with a boss in front, borne on cells which are somewhat inferior in size to the ordinary zoæcia.

Var. *a* (*conferta*). *Zoæcia* crowded, ovate or pyriform, rather short, strongly striated transversely, the connecting fibre rudimentary; orifice arched above, with a notch on the lower margin; a prominent umbo immediately below it. *Oæcia* rather large, rounded, broader

* I do not include Audouin's *H. divaricata* amongst the synonyms, as it possesses a very differently shaped mouth from that of the present species. It is the *H. Savignyana* of D'Orbigny.

than high, with a boss in front, borne on cells of the normal size.

Var. β (*carinata*, Norman). Zoëcia and connecting fibre traversed by a prominent ridge-like keel.

Var. γ (*Patagonica*, Busk). Zoëcia oval, more or less attenuated downwards, irregularly annulated, thick.

HABITAT. On shells (chiefly), stones, &c., from between tide-marks to deep water.

LOCALITIES. Generally distributed. Special localities must be accepted with caution, as this form has been hitherto confounded with *H. flagellum*. Var. β . Antrim (Hyndman): Birterbuy Bay (A. M. N.). Var. α . Sidmouth, on red weed (T. H.). Var. γ . ? Britain (Busk).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Lamx.): Roscoff, rare (Joliet): France, S.W. (Fischer): Bergen (A. M. N.): Arctic seas to Spitzbergen, on Ascidians, *Astarte*, *Saxicava*, in great depths (Smitt): Godhavn Harbour, Disco, 5–20 fathoms ('Valorous' Exped.): Gulf of St. Lawrence (Dawson): Mazatlan, on *Murex*; Hobson's Bay, Australia (T. H.). Var. *Patagonica*:—Patagonia and Falkland Islands, on *Fucus* (Darwin): Tasmania (Busk).

RANGE IN TIME. Pliocene, Castrocaro, very rare (Manzoni): Scotch Glacial deposits (Geikie): Palæolithic (A. Bell). Var. *Patagonica*:—Coralline Crag (S. W.): *Hippurite limestone*, St. Grégoire, near Rennes (Michelin).

Of the varieties of this common species with which I am acquainted, the most remarkable is the one described as var. α (*conferta*). In this form the zoëcia are generally massed together and laid side by side, and do not assume the ordinary dendritic mode of growth. Occasionally lines of cells arranged in single series are given off from the mass. The connecting fibre is very slightly developed;

generally the cells are somewhat produced below, so as to be pyriform, and are attached to one another by the base of the short peduncular extremity; sometimes three, sometimes two, originate from the top of another cell. The lateral branches do not usually stand out at a right angle, but take an ascending direction. The habit and mode of growth seem to resemble very closely those of the Crag species *H. abstersa*, Busk.

The cells, when crowded together, are rather short and ovate; they are umbonate, and traversed by very distinct transverse striæ. The orifice agrees in all respects with that of the normal *H. divaricata*. The ovicelligerous cells are not smaller than the rest. Notwithstanding the striking peculiarities of this form, I believe that it is properly referred to *H. divaricata*, which exhibits many variations in the length of the tubular fibre, and not unfrequently has the cells more or less massed together*.

The var. β is characterized by an exaggerated condition of the keel on the front of the cell. When seen in profile it stands out as a prominent ridge, but is abruptly truncated immediately below the orifice.

H. Patagonica, Busk, appears to be nothing more than a thick-walled and rudely annulated variety of the present species. As represented in the British-Museum Catalogue, it has some affinity with our var. *conferta*; but the figure in the 'Crag Polyzoa' makes a near approach to the ordinary *H. divaricata*.

In characteristic and well-developed specimens of the latter, branching takes place with much regularity at right angles or nearly so to the main lines of cells, and colonies exhibit a very definite dendritic habit.

* Dr. Johnston mentions a variety "in which the cells are contiguous." and which occurs on sea-weeds only.

HIPPOTHOA EXPANSA, Dawson.

Plate I. fig. 1.

HIPPOTHOA EXPANSA, Dawson, "Cat. Anim. and Plants observed on the South-east side of the St. Lawrence, from Quebec to Gaspé," &c. By Robert Bell. *Polyzoa* by Dr. Dawson. Geol. Survey of Canada, Report of Progress for 1858 (published 1859), 255: *Nerman*, Quart. Journ. Micr. Sc. 1868 (n. s.), viii. 216, pl. vi. figs. 1, 2.

Zoæcia large, ovate, elongate, ribbed transversely, and traversed by delicate longitudinal striæ, tapering below into a tubular stem; aperture arched above, with a sinus on the lower margin; peristome slightly raised; the cells and fibre bordered by a calcareous expansion of greater or less extent. *Oæcia* large, broader than high, umbonate, borne on an imperfectly developed cell.

HABITAT. On small pebbles and stones, from moderate depths to deep water (30–100 fathoms).

LOCALITY. Off Unst, Shetland, on *Pecten Islandicus*, 100 fathoms (Jeffreys and Peach).

GEOGRAPHICAL DISTRIBUTION. Gulf of St. Lawrence, common; Marsouin, north coast of Gaspé, in about 30 fathoms (Dawson): Labrador; Maine (Packard): lat. 66° 59' N., long. 55° 27' W., in 57 fathoms ('Valorous' Expedition).

RANGE IN TIME. Postpliocene deposits, Beauport and Rivière-du-Loup*, Canada (Dawson).

From *H. divaricata* this species is distinguished by its larger size (the cells are about half as large again as those

* "The assemblage of shells at Rivière-du-Loup is in almost every particular that of the modern Gulf of St. Lawrence, more especially on its northern coast."—DR. DAWSON, *Notes on the Postpliocene Geology of Canada*, p. 52.

of the last-named) and much stouter habit, by the very regular transverse ribbing of the zoœcia, and by the calcareous expansion which in greater or less degree borders the latter and the connecting tubular stem.

I have met with *H. expansa* in two very different conditions. In one the zoœcia are massed together, and the lateral expansion is much developed, and forms a connecting crust, which fills up the spaces between the cells and unites them together. In this form the branches originate, as Mr. Norman has remarked, from the side of a cell at a very slight angle. From the masses thus produced linear series of cells are given off, which sometimes anastomose and form an irregular wide-meshed network.

In the other condition *H. expansa* exhibits a very regular growth, having much the same habit as *Alecto granulata*. The zoœcia range in single lines and bifurcate frequently, two cells in each case arising from the top of the terminal cell of the series. In this form the calcareous edging is almost if not entirely wanting; there seems to be great variability in this character. When fresh the cells are beautifully hyaline and glossy, and very finely lineated longitudinally. The ovicelliferous cells, which are exceedingly small, are generally attached by a short stem to the side of another cell, as is usual in this genus. In all cases the tubular prolongation of the zoœcium seems to be of very moderate length in this species; and very commonly it is quite rudimentary.

Dr. Dawson was the first to notice and describe this form; but the list of *Polyzoa* in which he published it, included under a more general title and imbedded in a volume of the Canadian Survey Reports, escaped observation, and it was subsequently redescribed by Norman, who gave it the same name as its original discoverer. It is much more characteristically American than British,

and is fittingly associated with the name of one who has done so much to illustrate both the recent and fossil fauna of his adopted country.

H. expansa is a northern species, and is said to be much more abundant in the Arctic seas than the kindred *H. divaricata*.

HIPPOTHOA FLAGELLUM, Manzoni.

Plate XLIV. figs. 5-7.

HIPPOTHOA FLAGELLUM, *Manzoni*, Bryoz. foss. Ital. 4th Contrib. 6, pl. i. fig. 4 (Sitzb. d. k. Akad. d. Wissensch. Bd. lxi. 1. Abth. März-Heft, 1870); *id.* Suppl. alla Faun. d. Bryoz. Medit. 1st Contrib. 3, pl. i. fig. 5 (*l. c.* Bd. lxiii. 1. Abth. Feb.-Heft, 1871): *Hincks*, Ann. N. H. Sept. 1877, 218.

Zoæcia ovate, smooth, not carinated, slightly elevated towards the oral extremity, not much produced below, connected by a very slender thread, usually much longer than the cell; orifice subovate, elongate, broader above than below, with a slightly thickened peristome. *Oæcia* small, globose, smooth, borne on a partially developed cell, which is generally attached to the side of a normal zoæcium by a very short fibre.

HABITAT. On shells chiefly.

LOCALITIES. *H. flagellum* seems to be common and widely distributed; probably it is as common as *H. divaricata*, with which it has hitherto been confounded. I am only able to give the localities which have come under my own notice. Guernsey; Cornwall, on stones from deep water; South Devon; Hastings; Isle of Man; coast of Antrim (amongst Mr. Hyndman's dredgings): *ibid.*, 47 fathoms, and 62-72 fathoms, off the Maiden Lighthouses (amongst Mr. Swanston's dredgings): Birterbuy Bay; Shetland, on *Ditrupa*, bearing *Retepora Beaniana* (T. H.).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Manzoni) : Singapore, on *Tubipora musica* (T. H.).

RANGE IN TIME. Pliocene deposits (newer), Calabria; Castrocaro ("Pliocene antico") (Manzoni).

This is a smaller and more delicate species than *H. divaricata*, and may be at once distinguished from it by the shape of the orifice. The cells are rather less produced below than those of the last-named; they are smooth or slightly wrinkled transversely, and want the keel which, in a more or less pronounced form, is always present in *H. divaricata*.

The cell rises a little towards the upper extremity; and the elongate obovate aperture is therefore prominent and conspicuous. In this respect the species differs markedly from *H. divaricata*, in which the *middle* of the cell is elevated, and the wall slopes away from the centre towards the upper extremity, so that the mouth is placed slantwise and is less apparent when the cell is viewed in front. The ovicelligerous cells are very small, much smaller as compared with the normal cell than those of *H. divaricata*; the ovicell is regularly globose, smooth and shining, and destitute, I believe, of the kind of boss on the front which occurs in the latter species.

The fibre is extremely slender, and, though variable, generally much exceeds the cell in length.

I have met with a very pretty variety (*vitrea*), in which the cells are exceedingly small, perfectly vitreous and transparent, and very widely separated, the connecting fibre being three or four times the length of the zoëcia.

[HIPPOTHOA CASSITERIDES, Couch.

HIPPOTHOA CASSITERIDES, Couch, *Johnst.* Br. Zooph. i. Suppl. 476, woodcut, fig. 87.

I only know this species by the description in Johnston's

‘History;’ I suspect it may have been founded on the repent condition of *Eucratea chelata* (see Plate I. fig. 3).

The following is the diagnosis:—

Zoæcia ovoid (more pear-shaped than those of *H. divari-cata*), connected by a short, stout thread, about one third the length of the cell; orifice longitudinally oval, rather large, with thickened rim; a short distance from the lower lip a small pearly tubercle, larger in one cell than another.]

Family XIV.—**Escharidæ** (part.), Smitt.

CELLEPORIDÆ (part.), Johnston.

ESCHARIDÆ (part.), id.: Busk.

MEMBRANIPORIDÆ, (part.), Busk.

ZOARIUM calcareous, incrusting, or erect and lamellate, or ramose. *ZOÆCIA* without a membranous area or raised margins: (a) with a simple primary aperture, horseshoe-shaped, or semielliptical, or suborbicular; or (b) with an elevated secondary orifice inclosing an avicularium; or (c) with a primary orifice having a dentate lower margin and a secondary orifice channelled in front or entire; or (d) with the lower margin elevated into a mucro: in all cases destitute of a true sinus and special pores.

THIS may at first sight appear a somewhat miscellaneous assemblage of forms; and no doubt it is largely distinguished by negative characters. But on closer examination it will be found that there is a thread of affinity running through the whole and linking together the different genera, and that the group is marked by common features and tendencies of much significance. It embraces the residue of forms belonging to this section which do not rank under any of the preceding families, and amongst which there does not seem to be any such

striking difference of type as to call for the creation of a distinct group. The primary orifice ranges in the different genera from semicircular (which seems to be the simplest and most primitive form), through semielliptical and sub-orbicular, to subquadrangular and horseshoe-shaped.

A striking characteristic of the family is the development of a secondary orifice under various modifications, or the elevation of the peristome into a mucronate process in front. The dentate lower margin is also found only in this group, and occurs in more than half the genera composing it. In no case is there a sinus on the inferior margin of the primary orifice, nor is there any trace of the special pores which occur amongst the *Microporellidæ* and *Porinidæ*.

The erect habit of growth is common in this family. It contains no less than eight British species which would rank under the genus *Eschara* (auctt.).

It may be divided into three principal sections:—i. Species with a simple primary orifice only: Genera *Lepralia* and *Umbonella*. ii. Species with a secondary orifice differing in form from the primary: Genera *Porella*, *Escharoides*, *Smittia*, *Phylactella*. iii. Species with a mucronate elevation of the peristome: Genera *Mucronella*, *Palmicellaria*, *Rhynchopora*.

The difference between the genus *Smittia* in the second of these sections and *Mucronella* in the third lies really, as I have noticed elsewhere, in the extent to which the secondary development of the peristome is carried. In *Umbonella verrucosa*, amongst the simpler forms, the rising which supports the avicularium is, I believe, the equivalent of the secondary chamber below the primary orifice in *Porella**. In *Lepralia Pallasiana* and *canthariformis*,

* We may also trace a connexion between the latter and such a form as *Smittia Landsborovii*.

belonging to the same section, we see the tendency to the secondary development of the peristome which is so strongly marked in this family.

i. *With a simple primary orifice only.*

Genus LEPRALIA, Johnston (part.).

Der. From λέπρα scurf, and ἄλιος marine.

ESCHARA (part.), auctt.

LEPRALIA (part.), auctt.

LEPRALIA, Smitt.

GENERIC CHARACTER.—ZOÆCIA *usually ovate, with the orifice more or less horseshoe-shaped, arched above, contracted at the sides, and with the lower margin entire and generally slightly curved outwards.* ZOARIUM (*in the British species*) *incrusting, or rising into foliated expansions composed of one or two layers of cells.*

LEPRALIA PALLASIANA, Moll.

Plate XXXIII. figs. 1-3; and Plate XXIV. fig. 4.

ESCHARA PALLASIANA, *Moll*, Seerinde, 64, pl. iii. fig. 13.

CELLEPORA PALLASIANA, *Lamx.* Pol. flex. 95, no. 190.

FLUSTRA HIBERNICA, *Hass.* Ann. N. H. vi. 172, pl. vii. fig. 1; *ibid.* vii. 370.

LEPRALIA PEDILOSTOMA, *Hass.* Ann. N. H. vii. 368, pl. ix. fig. 4 (not the *L. pedilostoma* of Couch).

LEPRALIA PEDIOSTOMA, *Johnst.* B. Z. ed. 2, 315, pl. lv. fig. 7.

LEPRALIA PALLASIANA, *Busk*, Mar. Pol. ii. 81, pl. lxxxiii. figs. 1, 2; *Crag* Pol. 54, pl. ix. fig. 7; (var. *armata*) *Quart. Journ. Micr. Sc. Zoophytol.* iv. 309, pl. xi. figs. 1, 2; *Hincks*, Devon Cat., Ann. N. H. ser. 3, ix. 204; *Smitt*, Cefv. K. Vet.-K. Förh. 1867, Krit. Fört. iv. 19 and 123, pl. xxvi. fig. 93.

Zoæcia large, broad-ovate, distinct, coarsely punctured over the entire surface, disposed in lines; orifice ample, longer than broad, arched above, contracted on each side below the middle, lower margin slightly curved

outwards; peristome elevated, thickened, unarmed, forming a conspicuous border round the mouth, sometimes much raised, so as to be almost infundibulate, and often rising on each side into a pointed process; commonly an umbo below the mouth. Frequently an *avicularium* immediately under the inferior margin, with semicircular mandible directed downwards. *Oæcia* none (?).

Colonies forming large subcircular crusts.

Primary cell small, the orifice occupying a large portion of the front surface; in other respects normal.

Polypide with 16 slender tentacles, forming a rather deep bell.

RANGE OF VARIATION. The characters are on the whole very constant. When old the crust is thickened and coarsely reticulated; occasionally the surface is traversed longitudinally by raised anastomosing ridges. The umbo below the mouth is often absent; while at times it is developed into a tall spike-like process. A variety occurs in which the peristome is much produced; and in this condition the species makes an approach to *L. canthariformis*, Busk (Plate XXIV. fig. 4). The avicularia are often wanting.

HABITAT. On shells and stones (chiefly) between tide-marks, and in very shallow water; rarely in deeper water.

LOCALITIES. Cornwall (C. W. P.): South Devon, abundant, the predominant littoral species on the southwestern coasts; Guernsey; Lulworth, under stones, on a remarkably rough and barren shore; Llandudno; Isle of Man, common (T. H.): Jersey (Alder): Tenby (Busk): Berwick Bay, very rare (Johnston): Bamborough and Cullercoats, Northumberland (Alder): Thurso; Wick (C. W. P.): Ayrshire (Landsborough): Dublin Bay (Hassall): off the Copelands, Belfast Bay, deep water (W.

Thompson) : the Minch ; Shetland, common, between tide-marks (A. M. N.) ; Orkney (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Rhode Island and New Jersey (Leidy) : Bahusia and Southern Norway, the most common littoral species (Smitt) : France, S.W., 6-10 fathoms (Fischer) : Roscoff (Joliet) : Adriatic, on shells, stones, and Algæ, pretty common (Heller) : 7-10 fathoms, island of Lussin, Adriatic (Grube) : Mediterranean (Lamx.).

RANGE IN TIME. Coralline Crag (S. Wood).

This handsome species is for the most part a littoral form, and is extremely abundant between tide-marks on many parts of our coast. The smaller pebbles are often completely incrustated by it.

In young cells the front wall is thin and silvery, and covered with simple circular punctures ; but with age a thick glassy crust forms over the primitive lamina. In this state the ridges between the foramina frequently rise into prominent nodules.

According to Smitt, *L. Pallasiana* occasionally assumes the Hemescharine habit, and forms free and erect expansions.

LEPRALIA CANTHARIFORMIS, Busk.

Plate XXXIII. fig. 4.

LEPRALIA CANTHARIFORMIS, *Busk*, Quart. Journ. Micr. Sc. viii. (1860), 143, pl. xxvi. figs. 3, 4.

LEPRALIA PALLASIANA, var., *Norman*, Shetland Pol., Rep. Brit. Assoc. for 1868, 307, 308.

“*Zoæcia* broadly ovoid, surface granular, punctate, shining ; orifice large, suborbicular, oblong or irregular ; peri-

stome much produced, often infundibuliform, entire.” (Busk).

HABITAT. On shell, probably from deep water.

LOCALITY. Shetland (Barlee).

This species is evidently allied to *L. Pallasiana*, and especially to the variety with a much elevated peristome. At the same time, in the absence of specimens, I do not venture to pronounce them identical. Judging from the description and figure, there are several points of difference between them. The cells are broader in *L. canthariformis*, and very distinctly granulated, a condition which I have not observed in *L. Pallasiana*. The mouth, which is definitely horseshoe-shaped in the latter, seems to be very irregular in form in the present species, while the peristome is much more highly developed in *L. canthariformis* than I have ever seen it in *L. Pallasiana* (compare Plate XXXIII. figs. 3 and 4). Provisionally at least the two must be accounted distinct.

LEPRALIA FOLIACEA, Ellis and Solander.

Plate XLVII. figs. 1-4.

ESCHARA RETIFORMIS, *Ray*, Syn. i. 31: *D'Orb.* Pal. franç. Terr. crét. v. 101.

STONY FOLIACEOUS CORALLINE, *Ellis*, Corall. 71, no. 3, pl. xxx. figs. a, A, B, C.

PORUS CERVINUS, *Ellis*, Corall. 72, pl. xxx. fig. b (=var. a, *fascialis*).

MILLEPORA TENIALIS, *Ell.* & *Sol.* Zooph. 133 (=var. a.).

ESCHARA FASCIALIS (vars. LAMELLOSA and FASCIALIS), *Pall.* Elench. 43: *Moll.* Seerinde, 31, pl. i. figs. 1, 2: *M.-Edwards*, Recherches sur les Eschares, 39, pl. iv. fig. 1.

MILLEPORA FOLIACEA, *Ellis* & *Sol.* Zooph. 133.

CELLEPORA LAMELLOSA, *Esper*, Pflanz. Cellep. 146, pl. vi. figs. 1-5.

ESCHARA BIDENTATA, *M.-Edwards*, (=var. β), Recherches sur les Eschares, 38, pl. iii. fig. 2.

ESCHARA FOLIACEA, *Lamk.* An. s. Vert. ed. 2, ii. 266: *Milne-Edw.* Ann. d. Sc. Nat. vi. 36, pl. iii. fig. 1: *Couch*, Corn. Faun. pt. iii. 131: *Johnst.* B. Z. ed. 2, 350, pl. lxxvii.: *Busk*, B.M. Cat. ii. 89, pl. cvi. figs. 4-7; *Heller*, Bryoz. d. Adriat. Meer. 38: *Manzoni*, Bryoz. foss. Ital., Contr. iv. 18, pl. i. fig. 4, and pl. iv. fig. 24, &c.

Zoarium foliaceous, membrano-calcareous, rising from a spreading crust, composed of thin expanded plates, sinuous and variously contorted, with an entire margin, which frequently anastomose and form cavities of different shapes and sizes; when living, of a delicate flesh-colour. *Zoæcia* disposed in two layers placed back to back, or occasionally in one layer only, ovate-elongate, or rhomboid, quincuncially arranged, separated by lines, very moderately convex; surface punctured and often nodulous, the punctures frequently surrounded by thick reticulated ridges, sometimes areolated round the margin; orifice arched above, contracted a little below the middle, where there is a small denticle on each side, the lower margin almost straight, or very slightly elevated in the centre; immediately below it a prominent central *avicularium*, with a rounded mandible pointing downwards, sometimes replaced by a spatulate *avicularium*. *Oæcia* large, often subimmersed, a little flattened in front, smooth and shining; in fertile cells the peristome is raised at the sides, and carried up on the front of the ovicell.

Colonies forming large foliated and chambered masses, of very brittle texture and of a brownish colour, when dead.

Var. *a* (*fascialis*). Divided into narrow, ligulate segments, frequently anastomosing.

Var. *β* (*bidentata*, M.-Edwards). A pointed projection encroaching on the orifice at each side, and giving it a trifoliate appearance (Plate XLVII. fig. 4).

RANGE OF VARIATION. In the young cells the walls are

thin and delicate in texture, and only slightly roughened. The punctures show as mere circular depressions closed in by membrane. Calcification, however, proceeds rapidly; and already in the second or third row from the margin of the colony, ridges are growing up amongst the pores; these anastomose as they rise, and the original surface is very soon concealed by a thick vitreous crust, pierced by as many deep circular shafts as there were punctures on the primitive wall. In the early state the peristome is elevated; but as the crust thickens, the orifice is on a level with the surface of the cell.

The zoœcia are liable to some variation in form, and are often much elongated and subquadrangular.

The avicularium is generally small, with a rounded mandible, and placed immediately under (and outside) the lower margin; but occasionally it assumes a lengthened spatulate form.

The var. β , which Milne-Edwards has described as *Eschara bidentata* (Plate L. fig. 4), is distinguished by having a dentate process on each side of the orifice, and overhanging it, which gives it a decidedly trifoliate appearance. In all other respects it seems to agree with the normal form. These dentate processes are, I believe, quite superficial. In certain states a thin membranous envelope invests the cells, concealing the punctured crust, and covering the zoarium with a smooth and somewhat glossy epidermis. The lateral processes originate from this superficial layer, and have no connexion with the underlying calcareous crust.

Occasionally the zoarium of *L. foliacea* assumes a Hemescharine mode of growth; but usually it is bilaminar, and its broad foliated expansions, variously contorted and anastomosing freely, form large cavernous masses, often of enormous size. Striking, however, as its habit is

and its luxuriant growth, it differs in no respect either in the plan of its gemmation or the character of its cell from the simply incrusting forms with which it is associated.

For the occurrence of the remarkable variety *fascialis*, which is common in the Mediterranean, on our coasts, we have only the authority of Pallas, who says that he had seen a specimen from the Isle of Wight. Milne-Edwards considered it to be a distinct species; but Pallas tells us that he had seen many transitional forms between it and the common lamellate variety, and had no doubt of their specific identity.

Joliet has observed two varieties of this species at Roscoff—one red, which is the commoner, and the other white; in the latter both the living portions of the colony and the bells of the polypides are of a very pale colour*.

HABITAT. On shells and stones (chiefly) from deep water.

LOCALITIES. Isle of Wight, on oysters (Ellis): South Devon, common, off Budleigh, Exmouth, &c.; Ilfracombe, off the Capstone; Guernsey (T. H.): Sussex, frequent (Dillwyn): about 2 miles N.N.W. from the Eddystone, very common; off the Deadman, occasionally (Couch): Falmouth Bay (Miss Vigors): off Cape Clear (W. Todhunter): Isle of Man (Dr. G. D. Brown): the Minch, Hebrides (A. M. N.). This is the most northern locality yet recorded. Var. *a*. South Devon (T. H.).

GEOGRAPHICAL DISTRIBUTION. Mediterranean (M'Andrew): Adriatic, on stones, not common (Heller): *ibid*. Lussin, 24 fathoms (Grube): Algiers (J. Y. J.): La Charente Inférieure and La Gironde, sometimes in enormous masses (Fischer): Roscoff, very common (Joliet):

* 'Bryozoaires des côtes de France,' 1877, p. 99.

Naples, Hemescharine as well as the usual form; also var. *a.* (A. W. Waters): Cape of Good Hope; Indian Ocean (Pallas).

RANGE IN TIME. Italian Pliocene (Manzoni): Sicilian Pliocene, Brucoli (A. W. Waters).

This species not unfrequently occurs as a simple crust*, and in this state bears a very strong resemblance to *Lepralia Pallasiana*. In its erect and foliated condition it often attains a luxuriant growth, and forms large coral-like masses. The usual height of specimens is from 3 to 4 inches; but Couch mentions that he had seen one hooked up by a fisherman off the Eddystone, which measured 7 feet 4 inches in circumference and 1 foot in depth. Off the South-Devon coast it occurs abundantly, and often attains a large size; but I have seen nothing approaching this Cornish giant. Being thin and extremely brittle, it is very liable to be broken up by the dredge; and usually only fragments reach the surface. In its sheltered cavities many creatures find a home, while the incrusting Polyzoa spread in great luxuriance over its even surface†.

L. foliacea is essentially a southern form: on the warmer western side of Scotland it has been taken in the Minch; and this is so far its most northerly locality.

* "The first appearance of its rising into a lamellated form is the production of detached ridges and papillary eminences; as these become more elevated they assume the form described above."—COUCH, *Cornish Fauna*, iii. p. 132.

† *Membranipora Flemingii* and *Membraniporella nitida* are very commonly found upon it.

LEPRALIA PERTUSA, Esper.

Plate XLIII. figs. 4, 5.

CELLEPORA PERTUSA, *Esper*, Pflanz. Cellep. 149, pl. x. fig. 2.ESCHARINA PERTUSA, *Milne-Edwards*, Lamk. An. s. Vert. ed. 2, ii. 232.ESCHARINA PERLACEA, *id.* ibid. ii. 234.CELLEPORA PERLACEA, *W. Thompson*, Ann. N. H. x. 20.LEPRALIA PERTUSA, *Johnston*, B. Zooph. ed. 2, 311, pl. liv. fig. 10: *Busk*,
B.M. Cat. ii. 80, pl. lxxviii. fig. 3 (? figs. 1, 2), pl. lxxix.
figs. 1, 2: *Heller*, Bryoz. d. Adr. Meeres, 35, &c.ESCHARELLA PERTUSA, *Smitt*, Flor. Bryoz. pt. ii. 55.

Zoæcia large, regularly ovate, tumid, distinct, separated by raised lines; surface covered with punctures; orifice suborbicular, contracted below by two lateral denticles, the lower margin slightly curved outwards; usually a tubercle below the mouth, which sometimes rises into a well developed mucro; peristome slightly thickened, unarmed; rarely an *avicularium* on one side, a little below the orifice, with semicircular mandible directed obliquely upwards. *Oæcia* globose, somewhat depressed in front, thickly covered with punctures of different sizes, and with a smooth border round the base.

Colonies forming circular patches, the cells radiating from a common centre, of a fine orange colour; very bright and silvery when fresh.

RANGE OF VARIATION. Busk credits this fine species with a large amount of variability; but I confess I should give it a very different character. As I have found it, it is remarkably constant in all its leading features, and at once recognizable by its large, ovate, and very tumid cell, and its almost circular mouth*. I have never met with any variety of it at all resembling the form represented

* The orifice is slightly elongated transversely.

in plate lxxviii. fig. 2, of the 'Catalogue,' which has a depressed subquadrangular cell, and a sinus on the lower lip. Norman conjectures that this figure, as well as fig. 1 on the same plate, may have been drawn from specimens of his *Hemeschara sanguinea*. This is not improbable; but at any rate they cannot, I think, be referred to *L. pertusa*.

The tubercle below the mouth is occasionally replaced by a well-developed mucro. The avicularium seems to be very sparingly developed, and has hitherto escaped notice. When old and strongly calcified, the cells are covered with a thick network of stone.

HABITAT. On shells, stones, &c. from shallow to deep water.

LOCALITIES. Isle of Man (E. Forbes) : Cornwall (C. W. P.) : South Devon, very common; off the Deadman, 40 fathoms; Guernsey (T. H.) : Tenby (F. Walker) : coast of Antrim, deep water; off Sana Island (Hyndman) : Orkney (Lieut. Thomas) : Shetland, "on shells, especially *Ditrupæ*, and stones, 40-100 fathoms" (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Adriatic, common on stones, mussels, and Algæ (Heller) : Lussin Island, 9-10 fathoms (Grube) : Australia (Macgillivray) : New Zealand, on shells and coral (F. W. Hutton) : Fiji and Samoa Islands (*fide* Kirchenpauer) : Anticosti and Mingan Islands; South Labrador (Packard) : Florida, 60 fathoms (Pourtales) : Mazatlan, on *Murex bicolor* (T. H.) : Greenland (North German Polar Exped.) *.

* I give some of these localities with a certain measure of doubt. There seems to have been some difficulty in identifying *L. pertusa*. The form from the Italian Pliocene deposits and from the Mediterranean, figured by Manzoni under this name, is certainly not the present species, but is referable to *Schizoporella sanguinea*.

RANGE IN TIME. Scotch Glacial deposits (Geikie) : Palæolithic (A. Bell).

In *L. pertusa* the shape of the orifice varies somewhat from the generic type, but the structure is essentially the same as in the other species with which it is associated. Smitt ranks it amongst the *Myrizoidæ* ; but it wants the distinguishing character of this family. Its peculiarity is that the two lateral projections by which the orifice is constricted are placed very close to the inferior margin, which curves slightly outwards immediately below them ; but there is no approach to a sinus.

LEPRALIA ADPRESSA, Busk.

Plate XXXIII. figs. 5-7.

LEPRALIA ADPRESSA, *Busk*, B.M. Cat. ii. 82, pl. cii. figs. 3, 4 ; Quart. Journ. Micr. Sc. iv. 178, pl. viii. fig. 6 (Zoophytol.) : *Hincks*, Devon & Cornw. Cat., Ann. N. H. ser. 3, ix. 205.

LEPRALIA LATA, *Busk*, Quart. Journ. Micr. Sc. iv. 309, pl. x. figs. 1, 2 : *Manzoni*, Bryoz. Plioc. Ital., Contr. prima, 4, pl. i. fig. 6 ; Supplem. Contr. prima, 8, pl. iii. fig. 2.

Zoæcia lozenge-shaped or irregularly ovate, depressed, quincuncial, surface punctate in young cells, minutely granular at a later stage, sometimes obscurely reticulated ; orifice narrow, much longer than broad, arched above, contracted a little below the middle, inferior margin straight ; peristome slightly thickened, frequently a knob on each side on a line with the lower margin. *Oæcia* rounded, granular, closely united to the cell above, occasionally umbonate.

Colonies forming flat, compact, and inconspicuous crusts.

Var. α . Surface marked with grooves radiating from the lower border of the mouth.

RANGE OF VARIATION. The South-American specimens on which Mr. Busk's description of *Lepralia adpressa* was founded are characterized by a strongly grooved surface, which I have never met with in British or Mediterranean examples. The latter agree more completely with his *L. lata*; but there really seems to be no important difference between these two forms. There is no marked sculpture of any kind on the species as it occurs in our seas. In young cells the surface is thickly punctured, and bright and glossy; but the punctures are soon surrounded by reticulated ridges, and then almost obliterated, so that the surface is merely pitted; at a later stage they disappear altogether, and it becomes dense and almost smooth. The knobs on each side of the orifice are sometimes present on almost every cell, while in other cases they are rarely met with. Occasionally they attain a large size, and constitute a very striking feature; the ovicell is also sometimes crowned by a prominent umbo.

HABITAT. On shells, chiefly small univalves, from moderate depths to deep water.

LOCALITIES. Torbay (T. H.): Guernsey (A. M. N.): Hastings (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. Chiloe, 96 fathoms (Darwin): Mazatlan, abundant, on *Columbella* and *Pisania* (P. P. Carpenter): Bay of Gibraltar (Landsborough): Algiers (J. Y. J.): Naples (A. W. Waters).

RANGE IN TIME. Italian Pliocene (Manzoni).

LEPRALIA HIPPOPUS, Smitt.

Plate XXXIII. figs. 8, 9.

LEPRALIA HIPPOPUS, *Smitt*, *Öfv. af Kongl. Vet.-Ak. Förh.* 1867, Bihang, Krit. Fört. iv. 20 and 127, pl. xxvi. figs. 99-105.

Zoæcia ovate, moderately convex, not deeply divided, arranged quincuncially, occasionally bordered by a raised line; surface almost smooth, with a hyaline lustre (in the young state), or obscurely granulated or roughened by anastomosing ridges, with a number of large punctures round the edge, and usually a central mucro; orifice longer than broad, well rounded and expanded above, constricted on each side a little above the lower margin, which is slightly curved outwards; oral spines 2-4; an *avicularium*, with a rounded mandible pointing upwards, on one side, often a little below the mouth, placed obliquely. *Oæcia* globose, subimmersed, smooth or pitted, with a prominent mucro on the front.

RANGE OF VARIATION. In young marginal cells the form is distinctly marked, the front moderately convex, rising towards the central umbo; the surface almost smooth, or slightly roughened, or reticulated, glossy, and of a bluish grey tint. In the central portions of the colony the walls are much thickened and roughened, and, as a consequence, the divisions between the cells are almost obliterated, the surface is of a more uniform level, and the mouth more or less depressed. The avicularia vary in position: sometimes they are placed about the middle of the side of the orifice, sometimes a little below it; and occasionally there are two, one on each side. Rarely an elevated avicularium of an abnormally large size is met

with ; and I have seen a space, formed by an aborted cell, occupied by a group of four or five. In some cases the cells are bordered by a raised line ; but it is more commonly wanting. I have never met with more than two spines, and in a large proportion of cases there are none. Smitt, however, states that there are usually four in the younger colonies.

HABITAT. On shells, stones, Ascidians, the tubes of Annelids, &c. from moderate depths.

LOCALITY. Coast of Northumberland (Alder).

GEOGRAPHICAL DISTRIBUTION. Finmark, on *Rhynchonella* (Lovén) : Spitzbergen (Swedish Exped.) : Greenland (Lütken) : Gulf of St. Lawrence (Dr. Dawson).

RANGE IN TIME. Postpliocene, Canada (Dawson).

There is a close relationship between this species and *L. adpressa* ; but I have no doubt that they are properly accounted distinct. *L. hippopus* is much the larger of the two, and assumes in the adult state a much more massive character and a coarser habit. The mouth is very similar in both ; yet there are differences which, if slight in themselves, are not without significance in the aggregate. In *L. adpressa* it is narrower and taller in proportion to its breadth than in the other form, the constriction takes place higher up, and the projections or denticles on the side are less strongly marked. On the other hand, in *L. hippopus* the upper part of the mouth expands considerably, the lateral projections are prominent, and are placed immediately above the lower margin, and the length is less in proportion to the breadth. In the former species avicularia and, I believe, spines are always wanting ; in the latter there is no trace of the knobs, which are almost always present in greater or less quantity on *L. adpressa*, and which are often so striking

a feature. The central mucro and the marginal punctures, which are pretty constant characters of *L. hippopus*, are absent in the kindred species. I may add that the two differ remarkably in general appearance, and that the one is (so far as we know) a northern and the other a southern form.

The only British example of *L. hippopus* which I have heard of, is from the Northumberland coast, and agrees in all respects with specimens from the Gulf of St. Lawrence, which I owe to the kindness of Principal Dawson of M'Gill University.

LEPRALIA EDAX, Busk.

Plate XXIV. figs. 7, 7 a.

CELLEPORA EDAX, *Busk*, Crag Pol. 59, pl. ix. fig. 6, pl. xxii. fig. 3; Quart. Journ. Micr. Sc. n. ser. i. 154, Zoophytol. pl. xxxiv. figs. 3, 3 a: *Hineks*, Devon Cat., Ann. N. H. ser. 3, ix. 304 (48 sep.).

LEPRALIA EDAX, forma TYPICA and forma CALCAREA, *Smitt*, Flor. Bryozoa, pt. ii. 63, pl. xi. figs. 220-223.

Zoarium rather massive, usually moulded on a small uni-valve shell, occasionally forming erect, pumicose stems. *Zoæcia* ovate rhomboid or hexagonal, very irregularly disposed, surrounded by a marginal line, and punctured round the edge; the cell-wall rising more or less towards a prominent umbo, placed below the mouth, which is often prolonged into a tall mucronate process; surface roughened, often striated by radiating furrows; orifice rounded and expanded above, contracted a little below the middle, where there is a small denticle on each side, lower margin slightly curved outwards; peristome not elevated, unarmed; small oval *avicularia* irregularly distributed, often wanting; large *avicularia*, with a pointed mandible, placed on a distinct area

bounded by a raised line, are occasionally present in considerable numbers, but are sometimes altogether absent. *Oæcia* rounded, sometimes almost immersed, sometimes suberect; a depressed area on the front, less strongly calcified than the rest of the surface, inclosed by a raised line, which takes the form of an arch; at the top of this area a transversely elliptical orifice closed in by a membrane.

Colour, when fresh, bright red.

RANGE OF VARIATION. There are very considerable differences in the elevation and convexity of the cells; in some cases they are much raised and have a mamillated appearance. According to Smitt the umbo is sometimes wanting; but generally it is a very prominent feature, rising at times into a spiked process. The punctures seem to be commonly confined to the base of the cell, where they form a single line; but I have seen them spreading over the entire surface. This seems, however, to be of very rare occurrence. The surface is sometimes smooth, but more generally roughened, and is very commonly striated by furrows passing upwards from the margin.

The oval avicularia are extremely irregular in their occurrence, and when present are only developed here and there over the colony. They are not noticed by Busk in his account of the Crag specimens, nor can I find them on that from the Devon coast; but on the Guernsey and Floridan specimens they are present.

The large pointed avicularia, each placed on a definite area as large as that of the zoæcia, are extremely rare on the British examples which I have seen. I believe I have detected one or two of them by diligent search; but on the Floridan form figured by Smitt they are numerous,

interspersed amongst the ordinary cells, and constitute a marked characteristic*.

HABITAT. Usually on small univalve shells (*Natica*, *Turritella*, *Trochus*, &c.) from moderately deep water.

LOCALITIES. Plymouth Sound; off Fermain Bay, Guernsey, in about 30 fathoms (T. H.): in one confined area off Guernsey, in 15–20 fathoms, incrusting *Trochus Montagu*, Wood, *Nassa incrassata*, Ström, *Trophon muricatus*, Montagu, &c. (A. M. N.): off the Deadman (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Florida, in 49 and 79 fathoms (Pourtales).

RANGE IN TIME. Coralline Crag (S. Wood): Middle Pliocene (Coralline and Red Crag) (A. Bell).

L. edax is found almost universally investing certain univalve shells, or rather occupying the place of the shell of certain Gasteropod mollusks. For it is a remarkable fact that in all cases the shell which served as the original site of the colony, has disappeared, and its place is filled and its form perpetuated by the crust of the Polyzoon. This is true of fossil as well as of recent specimens. The *Lepralia* possesses the power of eating away and removing the shell; and its own zoarium supplies a good and solid substitute for the house which it has supplanted. Busk has noticed (in Crag specimens), “that other shells, either entire or in fragments, together with minute pebbles, are occasionally found imbedded in the parasitic mass” †.

Smitt describes a form from the coast of Florida, which

* “The greater avicularia . . . have an inversely spatulate or a flask-shaped form of their aperture, with its linear produced tip pointing obliquely upwards.”—*Flor. Bryoz.* pt. ii. page 65.

† Crag Polyzoa, p. 60.

seems to be identical with the present, as "growing in raised stems of a pumicose consistence," and mentions that in one case a *Serpula* had "fixed itself upon such a colony, where at last it was enveloped by the overgrowing Bryozoon, and its calcareous shell, in the well-known manner, was eaten away"*.

The peculiarity in *the mode of growth* exhibited by this Floridan form has not been noticed either in Crag specimens or in those which have been obtained on our own coasts.

A species of Actinozoon presents us with a similar habit to that of *L. edax*. This is a *Zoanthus* described by Düben and Koren under the name of *Mamillifera incrustata*, which is commonly parasitic on shells tenanted by a species of *Pagurus*. In all cases the shell is destroyed after a while by some process of erosion or absorption, the diffused basal crust of the zoophyte forming a perfect cast of it, and affording shelter to the crab †.

An interesting peculiarity of the present species is the special aperture with which the oœcium is furnished, and which is placed at the upper end of the depressed area, on its front surface.

Another characteristic point is the extremely irregular disposition of the zoœcia. They lie in all directions, without the least uniformity of plan—now turned this way, now that, forming a confused medley, which contrasts strongly with the usually definite and methodical grouping of the cells amongst this family.

The first recent example of *L. edax* was obtained on the coast of Devonshire; and I have since dredged it off Guernsey, where it has also been taken by Mr. Norman.

* Floridan Bryozoa, pt. ii. p. 64.

† Hincks, Catalogue of Devon and Cornwall Zoophytes, Ann. N. H. ser. 3. vol. ix. p. 304.

It is probably not uncommon, but may easily have been passed by from its general and superficial resemblance to *Cellepora pumicosa*.

LEPRALIA POLITA, Norman.

Plate XXXII. fig. 5.

LEPRALIA POLITA, *Norman*, Ann. N. H. ser. 3, xiii. (1864), 87, pl. xi. fig. 1.

Zoæcia large, ovate, suberect, ventricose, deeply divided, irregularly arranged, the surface smooth and polished; orifice longer than broad, arched above, the lower margin straight or slightly curved outwards; 4-5 short oral spines, rarely present; peristome usually raised on each side into a knob-like process, which, in fertile cells, projects in front of the ovicell. *Oæcia* globose, recumbent, closely united to the cell above, smooth or minutely pitted.

Colonies forming small patches of a pinkish colour when living.

HABITAT. On shells and stones from deep water.

LOCALITIES. Shetland, 70-100 fathoms; the Minch, Hebrides (A. M. N.).

The cells are remarkable for their size and distinctness and for their smooth and highly polished surface. When dead the zoarium loses its pinkish tint, and is of a silvery greyish-white. The cells are very slightly raised towards the oral extremity, and often obscurely punctured round the base. The mouth is nearly semielliptical, the height exceeding the width considerably; the oral spines are seldom met with, but traces of them may generally be detected on some of the cells in a colony. There seems to be much diversity in the degree in which the peristome

is elevated and thickened. The nodulous processes on the sides are generally well developed in the fertile cells, and stand out prominently in front of the ovicell; in other cases they are sometimes inconspicuous, and sometimes wanting altogether. Very commonly the whole peristome is slightly raised and thickened, with the exception of the inferior margin, which is always simple.

It is not easy to determine the affinities of this species; but, in the absence of all striking features, the tall, arched orifice, with the lower margin almost straight and entire, seems to connect it with the present rather than with any other group.

Genus UMBONELLA.

Der. From *umbo*, a rounded elevation.

LEPRALIA (part.), Johnston, &c.

DISCOPORA (part.), Gray.

ESCHARA (part.), Smitt.

GENERIC CHARACTER.—*ZOÆCIA with the primary orifice suborbicular or subquadrangular, lower margin slightly curved inwards, peristome not elevated, no secondary orifice; a prominent umbo (? avicularian cell) immediately below the mouth, supporting an avicularium. ZOARIUM (in the British species) incrusting.*

IN this genus the primary orifice remains unchanged, as it usually does in *Lepralia*, but it exhibits a very different form from that which is characteristic of the latter. It is wide, well-arched above, with the sides slightly rounded, or somewhat compressed, and the lower margin a little curved inward. It is now suborbicular and now decidedly subquadrangular, but it never makes any

approach to the semielliptical and laterally constricted form which characterizes *Lepralia*. The hollow umbo-nate rising below the mouth, on which the avicularium is borne, is also, I believe, properly accounted a character of considerable (secondary) importance. It is as wide as the inferior margin, and extends for some distance over the front wall of the cell. The avicularium is placed in the centre of its inner aspect, resting on the lower lip of the orifice. This umbo may be regarded as a partially aborted cell, and is probably the equivalent, as I have elsewhere stated, of the chamber below the primary orifice in the genus *Porella*.

The Arctic form which Smitt describes as *Eschara verrucosa*, can hardly, I think, be the same as *Lepralia verrucosa* of Johnston and Busk. He speaks of the elevated sides of its peristome, and describes them as uniting with the margin of the ovicell, which, as he expressly states, is imperforate. These characters do not belong to our British form, which also exceeds the Arctic very considerably in size. In his latest paper, Smitt ranks his *Eschara verrucosa* as a "form" of *Porella compressa*, which seems to show pretty clearly that it must be quite distinct from the British species.

UMBONELLA VERRUCOSA, Esper.

Plate XXXIX. figs. 1, 2.

?CELLEPORA VERRUCOSA, *Esper*, *Cellep.* pl. ii. figs. 1, 2.

LEPRALIA VERRUCOSA, *W. Thompson*, *Ann. N. H.* xiii. 441; *Johnst. B. Z.* ed. 2, 316, pl. lvi. fig. 3; *Busk*, *B.M. Cat.* ii. 68, pl. lxxxvii. figs. 3, 4, and pl. xciv. fig. 6; *Heller*, *Bryoz. d. Adriat. M.* 27.

LEPRALIA RETICULATA, *Couch*, *Corn. Faun.* iii. 117, pl. xxii. fig. 9.

DISCOPORA VERRUCOSA, *Gray*, B.M. Rad. 126.

?? ESCHARA VERRUCOSA, $\beta\beta$, formæ costatæ, *Smitt*, *Œfv. K. Vet.-Akad. Förh.* 1867, Bihang, 22 and 142, pl. xxvi. fig. 135.

Zoæcia large, broad-ovate, or occasionally rhombic, bordered by raised lines, depressed below, elevated above, the front wall rising into a broad and prominent umbo a little below the orifice, which is often produced into a kind of rostrum; surface smooth or subgranular, strongly areolated round the margin, and traversed by radiating ridges; orifice ample, suborbicular, or often subquadrangular, arched above, the lower margin almost straight, slightly curved inward in the middle; usually an *avicularium*, with a semicircular mandible, on the inner side of the umbo. *Oæcia* semicircular, punctured in front, and surrounded by a thickened spinous border or crest.

Polypide red, with 20 to 30 tentacles.

Colonies forming large crusts, of a fine rose-red colour, spreading irregularly.

RANGE OF VARIATION. This species, under different conditions, exhibits a great variety of aspect. In the littoral form the walls of the cells are very slightly calcified; they are generally thin and smooth, or merely subgranular, and round the edge of the colony are often almost membranous. In some cases they appear as if covered with a thin, rather glossy, papyraceous material; the areolations round the margin are obscure; and there is a total absence of the radiating ridges. In the littoral variety the latter are always comparatively slender, and frequently extend for a short distance only from the margin. In young specimens the cells are hyaline and shining, the surface is perfectly smooth and of a bluish-grey tint, a white line runs round the cell a little above the base, inclosing the marginal areolæ, while the central portion is traversed by delicate longitudinal ridges and frequently

by concentric striæ. Specimens in this condition are extremely beautiful. With age the walls become dense and opaque white. The umbo is a very conspicuous feature; it is blunt and smooth, and very prominent. The avicularium is often almost hidden behind it; in some cases it is wanting, and I have met with a large colony on which scarcely one was to be found. While the avicularium is, in some cases, half-concealed and difficult to recognize, in others it stands out prominently and projects to some extent over the aperture.

When developed in deep water, *U. verrucosa* takes on a very different character. The walls are dense and solid, the ridges, which are continuations of the septa between the areolar spaces, become much thicker, and often rise into nodules and spinous projections; and the umbo is massive and roughened. The strongly marked ridges radiate from the margin to the umbo; and the space between them is occupied by a rather deep, loop-shaped depression. The ovicell, which I have never observed on the littoral variety, partakes of the same character: it is thickly perforated in front; and the punctured space is surrounded by a calcareous border, which rises into a number of spinous processes, forming a very handsome crest (Plate XXXIX. fig. 2).

Deep-water specimens are highly calcified, and the appearance of the species undergoes a corresponding change, but the leading features are unaffected.

The orifice, which does not change with age, is arched above, and the lower margin is almost straight or slightly sinuous. On each side of it the front wall is carried up for some distance, terminating above in a blunt extremity.

HABITAT. On the surface of rocks, stones, shells, *Laminaria*-roots, &c. between tide-marks, and in shallow water, and on shells &c. from deeper water (40 fathoms).

LOCALITIES. South Devon, rare; Polperro, between tide-marks; Cornwall, 40 fathoms; Ilfracombe, in clefts on the Capstone; Guernsey, about 30 fathoms (T. H.): Scarborough (Bean): Northumberland, frequent between tide-marks (Alder): St. Andrews, on roots of *Laminaria digitata* and stones near low-water mark, rather abundant (Dr. M'Intosh): Wick and Peterhead, plentiful (C. W. P.): Scotland, west (Dr. Landsb.): Shetland, tide-marks and shallow water (A. M. N.): Dublin coast (Miss Ball).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): Adriatic, on mussel-shells, rare (Heller): Greenland (Lütken).

RANGE IN TIME. Scotch Glacial deposits (Geikie): Palæolithic (A. Bell).

ii. *With a raised secondary orifice.*

Genus PORELLA*, Gray.

Der. From *πόρος*, an opening.

CELLEPORA (part.), Fleming.

ESCHARA (part.), Sars: Busk: Alder: Smitt: &c.

HEMESCHARA (part.), Norman, &c.

LEPRALIA (part.), Busk, &c.

PORELLA, Smitt.

GENERIC CHARACTER. ZOÆCIA *with the primary orifice semicircular; secondary (or adult) orifice elongate, inversely subtriangular or horseshoe-shaped, inclosing an avicularium, usually with a rounded mandible.* ZOARIUM

* Gray introduced this name, with a very insufficient diagnosis, for a genus of which he made *Esch. cervicornis*, Johnst., the type; and it will be convenient to retain it for the group to which the latter species belongs. Smitt, in his 'Critical Catalogue,' adopts it for a genus in which he places *P. concinna* and *P. lævis*; but *P. compressa* he relegates to his genus *Eschara*.

incrusting, or erect; foliaceous with a single layer of cells, or ramose.

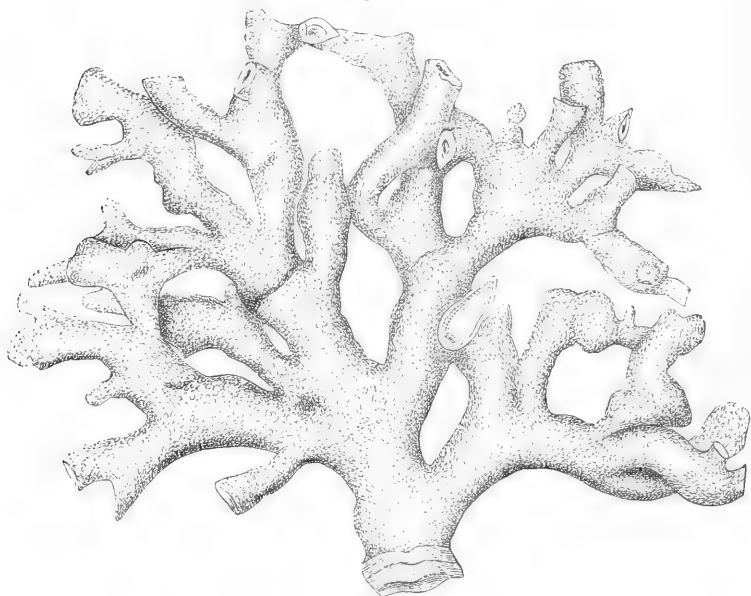
THROUGHOUT this very natural group there is a striking - uniformity, not only in the characters of the adult cell, but also in the course of its development; and the study of it has done more than most things to convince me that in this section of the Polyzoa we cannot safely regard the mere erect and branching habit as a generic criterion. If we examine a colony of the common *P. concinna*, we find in the marginal cells a plain semicircular opening, without any trace of the peculiar structure which is characteristic of the adult. In those which are somewhat older, the cell-wall begins to rise round the primitive aperture, and the outline of a secondary orifice is traceable, which extends for some distance below the former, narrowing off downwards, and so taking on the very distinctive shape which belongs to this species. As development proceeds the wall of this secondary orifice rises higher and higher, until it completely closes in the original opening and forms below it a chamber in which the avicularium is ultimately lodged. The primary semicircular aperture is covered by the operculum, and continues to be the real entrance to the interior of the cell; the secondary formation is an outwork, as it were, which to some extent protects the entrance, and affords a site for the avicularia.

We have precisely the same course of development in all the species which are grouped under this genus.

This arrangement could not stand, as these forms are most nearly allied, and cannot be separated in a natural system. In his later paper, on Polyzoa from Nova Zembla, he transfers *P. laevis* to *Eschara*, associating it with *P. compressa* and one or two other species. *Porella*, however, which is not encumbered with inconvenient associations, and which was first adopted by Smitt himself for part of the group, seems to me to be in all respects a preferable name.

In *P. compressa*, for instance, the phases of the cell-growth are, in all respects, similar to those which occur in *P. concinna*; and to separate these two forms would be

Fig. 14.



Porella compressa.

to make more of the erect habit than of the essential elements of the structure. If this course were adopted, there would be an indefinite multiplication of genera; for the same type of cell is found associated with very diverse modes of growth. Unless we are prepared to hold to the old method and allow the most external and superficial characters to rule, to the exclusion of those which are the real indications of affinity, we must, I think, found our genera in this division on the structure of the zoecium, and treat the ordinary variations of habit as merely subsectional.

Our only alternative would be, whilst grouping in the same family all the forms with kindred zoëcia, to found genera for the more striking variations of growth, as well as for the more important modifications of the cell. But as our object in classification is merely to indicate, as far as possible, natural affinities, we shall attain our end equally, and with more convenience, it seems to me, by the course which is here adopted.

a. *Zoarium incrusting.*

PORELLA CONCINNA, Busk.

Plate XLVI.

LEPRALIA CONCINNA, *Busk*, B.M. Cat. ii. 67, pl. xcix.: *Hinecks*, Devon and Cornwall. Cat., Ann. N. H. ser. 3, ix. 201 (41 sep.).

LEPRALIA APERTA, *Boeck*, Förh. Vid. Selsk. Christiania, 1861, 50.

PORELLA LEVIS, *Lepraliæ auctt. forma*, *Smitt*, Cfv. K. Vet.-Ak. Förh. 1867 (Bihang), 21 and 134, pl. xxvi. figs. 112-119.

LEPRALIA BELLI, *Dawson*, Rep. Geol. Surv. Canada, 1858, 256.

Zoëcia ovate or rhomboid, slightly convex, granular, often punctured round the margin, disposed in lines; orifice (adult) arched above, contracted below, longer than broad, lower margin straight, the cell-wall frequently raised and thickened round the mouth, a broad denticle set rather deeply within it; oral spines two; a small *avicularium*, with rounded mandible, on the lower lip, the front of the cell immediately below it often more or less mamillated. *Oæcia* globose, prominent, minutely granular, sometimes a single, central puncture in front; fertile zoëcia much raised and swollen towards the orifice*.

* They are so much elevated and enlarged towards the oral region that they appear as little hillocks studding the flat surface of the zoarium.

Colonies forming large, circular, reddish patches, very compact and neat in appearance.

Var. *a* (*Belli*, Dawson). *Zoæcia* flattish, granular, separated by a deep sinuous and punctured furrow; the front wall carried up on each side of the orifice into a digitiform process (Plate XLVI. fig. 6).

Var. *β* (*gracilis*). *Zoæcia* elongate, punctured over the entire surface (Plate XLVI. fig. 9).

RANGE OF VARIATION. This species changes its appearance considerably with age and the attendant thickening of the calcareous crust. It also assumes many varietal forms; but the differences which it exhibits are mainly superficial, and, with the exception of the avicularium, no important element of structure is much affected. When old it becomes coarsely granulous, and of a dead-white colour, the mouth is surrounded by a thick collar-like extension of the crust, the walls are massive, the perforations often very distinct and numerous, and the avicularium is sometimes obliterated, probably by the calcareous overgrowth.

The form of the mouth is very constant; and that of the cell itself is subject to but slight variation. But the differences in superficial character are numerous and striking. The surface is more or less granular; the marginal punctures are sometimes a marked character, but often they are altogether wanting*; frequently the mouth is surrounded by an elevated collar; in some cases this is replaced by a prominent umbo, immediately below the avicularium, and in others the whole central portion of the cell is mamillated. In other cases, again, the

* The marginal punctures may, I think, be regarded as an essential character, though they are often obliterated by the thickening of the cell-walls.

surface is even and uniform. But the avicularia exhibit the most remarkable variations. They are sometimes placed rather deeply within the mouth, and sometimes on the outer edge of the inferior margin, crowning the umbo immediately below it. Occasionally they are developed in large numbers, and distributed irregularly over the zoarium, each avicularium supported on a small mound-like prominence (Plate XLVI. fig. 12). At times they are modified in shape, as in *Schizoporella auriculata*, *S. armata*, and probably in many other species. The small circular avicularia are replaced, at least in a considerable number of the cells, by oval or spatulate avicularia of much larger size, which often cover a great part of the front surface (Plate XLVI. figs. 5 & 10).

Occasionally a large avicularium is present on a cell which bears one of the ordinary form and in the normal position. I have seen one mounted on a mamillary eminence which occupied the whole of the centre of the cell, with its mandible directed *upwards*, and almost in contact with the normal avicularium on the lower lip (Plate XLVI. fig. 10). Generally, however, the larger form replaces the latter, of which it is evidently a modification. These remarkable changes illustrate still further the instability of this structural element, to which reference has so often been made.

In the variety (α) described by Dr. Dawson as a species, in his valuable paper on the Invertebrata of the Gulf of St. Lawrence, the zoëcia have a somewhat sinuous outline, which changes very materially the general appearance, but has no significance as a specific character. The wall of the cell is carried up on each side of the mouth into a stout digitiform process—a condition which is met with in other varieties.

Very commonly in the fertile cells these portions of the

wall overlap the ovicell, and form two rib-like prominences in front (Plate XLVI. fig. 3). On the whole *P. concinna* must be accounted a variable species; but it is readily distinguishable under all its disguises by the peculiar character of the adult orifice.

HABITAT. On shells, &c., from shallow to deep water.

LOCALITIES. The species is common, and widely distributed. Belfast Bay, 20–25 fathoms; *ibid.*, deep water off the Copelands (W. T.): Isle of Man; Torbay; Guernsey, very abundant; off the Deadman, 60 fathoms (T. H.): Northumberland, deep-water boats, rare (Alder): St. Andrews (Dr. M'Intosh): Antrim, deep water (Hyndman): Shetland, 40–170 fathoms; the Minch (A. M. N.): Hastings (Miss Jelly): &c. With fine spatulate avicularia, Guernsey (T. H.). Var. *a*, Shetland (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Adriatic, on *Serpulæ*, rare (Heller): Bahusia; Finmark (Lovén): Norway (Sars): Spitzbergen, 20–30 fathoms (Swed. Exped.): Godhavn, Greenland (Torell): Gulf of St. Lawrence (Dawson). Var. *a* (*Belli*), Gulf of St. Lawrence (Dawson).

RANGE IN TIME. Scotch Glacial deposits (Geikie): Palæolithic (A. Bell): Postpliocene beds, Canada (Dawson).

PORELLA MINUTA, Norman.

Plate XXIX. figs. 1, 2; Plate XXXVI. figs. 6, 8.

LEPRALIA MINUTA, *Norman*, Shetland Pol., Rep. Br. Assoc. 1868, 308.

? LEPRALIA CHILOPORA, *Manzoni*, Bryoz. di Castrocaro, 32, pl. iv. fig. 51.

Zoæcia minute, distinct, divided by deep sutures, disposed in regular radiating lines, somewhat wedge-shaped, smooth or granular, strongly areolated round the

margin; primary orifice semicircular; secondary orifice arched above, slightly contracted below, the sides straight, somewhat inclined inwards, on the lower lip a rounded prominence (often with a crenated rim) supporting an *avicularium*, with semicircular mandible; the cell-wall sometimes much raised and thickened round the orifice, sometimes rising into a mucro in front. *Oœcia* subimmersed, rounded, smooth, or granular.

Colonies forming "very small roundish patches."

RANGE OF VARIATION. In the few specimens I have had the opportunity of examining the characters are on the whole very constant. The littoral form, however, of which I have received specimens from Mr. Peach, differs in some points from the deep-water form. It has the cell and ovicell smooth and of a delicate whiteness, while in the latter they are granular and comparatively coarse; the peristome is not thickened; the circular prominence which supports the avicularium is not so apparent, being partially concealed by the overhanging præoral mucro, which is strongly developed, and it has a plain rim, whereas in the deep-water variety the border is very prettily crenated. In the littoral specimens also the arched top of the orifice is carried across the front of the ovicell (Plate XXXVI. fig. 6).

In some cases the mucro is well developed; in others it is absent, and there is merely a swelling below the mouth.

The primary orifice, as seen in the marginal cells, is semicircular, without any elevation of the peristome.

HABITAT. Between tide-marks, on stones, shells, &c., and from deep water.

LOCALITIES. Shetland, very rare; Guernsey (A. M. N.): Wick, between tide-marks (C. W. P.): Antrim (Hynd-

man): Hastings (Miss Jelly). No foreign locality has been recorded.

RANGE IN TIME. Older Pliocene, Castrocaro (Manzoni): (if I am right in identifying *Lepralia chilopora*, figured by this author in his Monograph on the Polyzoa of Castrocaro, with the present species).

This species comes very near to *P. concinna*. The points of difference between the two may be briefly summed up. *P. minuta* is very inferior in size to *P. concinna*; its cells are more distinct, and divided by deeper sutures, and they are more pointed off below; they are also arranged more regularly and markedly in radiating lines. At times the rows of cells are rather widely separated, and the intervening space is crossed by connecting ridges, which pass at intervals from side to side.

The oœcium of the present species is less prominent than that of *P. concinna*. It may be added that in the latter the front of the cell is never mucronate, while within the lower lip there is a broad denticle, of which no trace exists in *P. minuta*.

The very close affinity between these two species is not apparent from Norman's description, as he has overlooked the presence of an avicularium. But there is no doubt that they are most intimately allied.

On one or two marginal zoœcia I have detected traces of a pair of spines.

b. *Zoarium incrusting, or erect and unilamellate.*

PORELLA STRUMA, Norman.

Plate XXXIX. figs. 3-5.

HEMESCHARA STRUMA, *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 221, pl. vii. figs. 6-8.

Zoæcia obovate, slightly convex, quincuncially arranged, the cell-wall much swollen immediately below the mouth, surface smooth or roughened by anastomosing ridges, a line of wedge-shaped areolæ round the margin, which become much more distinct with age; orifice (adult) broader than long, upper margin arched, the sides straight and slanting inwards, lower margin somewhat curved outwards; peristome unarmed; a rounded *avicularium* within the lower lip. *Oæcia* rounded, not much raised, smooth and silvery, or slightly roughened; closely united to the cell above.

Colonies forming a yellowish, glistening crust, which rises here and there into free frill-like expansions, not exceeding half an inch in height, and consisting of a single series of cells.

RANGE OF VARIATION. The description is founded upon comparatively young specimens. With age the species takes on a very different aspect. The front of the cells is covered with a thick glassy crust, which completely conceals the characteristic goitre-like enlargement below the mouth, obliterates the sutures between the cells, and forms a perfectly flat surface. On this the marginal areolæ appear as deep fissures, while the central portion is filled up with anastomosing ridges, separated by cavities of various size and shape. To add to the disguise, the cells are now inclosed by thick raised lines, which mark them out with great distinctness. In this condition

of course the mouth is sunk below the surface. In few cases is the appearance of a species so completely changed by age and the progress of calcification (Plate XXXIX. fig. 5).

HABITAT. On stones, and *Porella compressa*, from deep water.

LOCALITY. "About 25 miles north of the island of Unst, the most northern of the Shetland group," very rare (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.) : lat. $73^{\circ} 41' 6''$, long. $22^{\circ} 58' 30''$, in 220 fathoms (Dutch Arctic Exped.).

I have no hesitation in referring this species to the genus *Porella*. It is closely allied to *P. concinna*; it presents the very marked shape of the mouth, slightly modified in its proportions, which is characteristic of that species, while at the same time there is a complete parallelism between the two forms in the mode in which the orifice is developed.

c. Zoarium erect; branches compressed.

PORELLA COMPRESSA, Sowerby.

Plate XLV. figs. 4-7; woodcut, fig. 14.

PORUS CERVINUS, *Borlase*, N. Hist. Cornwall, 240, pl. xxiv. fig. 7.

MILLEPORA COMPRESSA, *Sowerby*, Brit. Miscel. i. (1806), 83, pl. xli.

CELLEPORA CERVICORNIS, *Flem. Br. An.* 532: *Johnston*, B. Z. ed. 2, 298, pl. liii. (*fide* Alder, who had examined the type specimen in the British Museum): *Couch*, Corn. Faun. pt. iii. 111, pl. xx. fig. 1: *Busk*, Ann. N. H. ser. 2, xviii. 32, pl. i. fig. 1: *Sars*, Reise Lof. Finn., N. Mag. f. Naturv. vi. 147 (27 sep.): *Alder*, Quart. Journ. Micr. Sc. n. s. iv. (1864), 98.

ESCHARA CERVICORNIS, *Busk*, B.M. Cat. ii. 92, pl. cix. fig. 7, cxix. fig. 1: *D'Orbigny*, Pal. Franç. l. c. 344: *Hincks*, Devon Cat., Ann.

N. H. ser. 3, ix. 308 (50 sep.): *Smitt*, *Escharæ* (auctt.) forma, l. c. 1867, Bihang, 23 and 149, pl. xxvi. figs. 138, 139; Bryoz. from Nova Zembla, l. c. 1878, no. 3, 11 (*not Millepora cervicornis* of Pallas, nor *Eschara cervicornis* of Milne-Edwards).

PORELLA CERVICORNIS, *Gray*, B.M. Rad. pt. i. 127.

? CELLEPORARIA SURCULARIS, *Packard*, Invertebr. Labrador, Mem. Boston Soc. N. H. i. (1867), pt. ii.

ESCHARA STELLATA, *Peach*, Journ. Linn. Soc. Zool. xiii. 481, pl. xxiii. fig. 5.

Zoarium erect, of a delicate flesh-colour when living, surface roughened by numerous prominent cells; much and irregularly branched; branches generally more or less compressed, occasionally roundish, truncate or bluntly pointed. *Zoæcia* on both sides of the zoarium, very irregularly disposed (except on the growing extremities of the branches, where they are regular and the surface smooth), ovate, ventricose, rising towards the mouth; surface dense, minutely roughened and punctured with rather large perforations round the margin; the younger cells often with ribs radiating from the side towards the centre; orifice (in the adult state) arched and expanded above, contracted below, sides slanting inwards, a slight constriction a little above the lower margin, forming a sinus in which there is an *avicularium*, with rounded mandible. *Oæcia* rounded, more or less immersed, surface smooth and entire.

Height of fine specimens about 3 inches.

RANGE OF VARIATION. In mode of growth there are many variations; but the minute characters are sufficiently stable. There is, in the first place, a marked difference in habit between southern and northern specimens. The former are much more massive than the latter; they have usually very broad and thick compressed branches, rendered irregular by many nodulous protuberances, which frequently anastomose and occasionally terminate above in somewhat palmate expansions. Shetland examples,

on the contrary, are usually much more delicate, their branches are comparatively slender, and the whole zoarium has a lightness and elegance which are wanting in the ordinary Cornish form. The branches in this species are, as a rule, decidedly compressed, and the ramification is, for the most part, irregular and intricate. In a Shetland variety, however, which I owe to Mr. Norman, the zoarium is very sparingly ramified, and the branches are elongate, nearly simple and roundish. In southern specimens the stem is often of great thickness towards the base, measuring as much as half an inch in diameter.

The cell of *P. compressa* seems to be liable to very little variation, except such as is connected with age and the several stages of growth. Within the limits of one and the same colony indeed it presents very different appearances according to its position. Towards the growing extremity of the branches the zoœcia are regularly disposed, immersed, and often punctured over the surface. These portions of the zoarium, in the smoothness of their surface and the regularity and neatness of their appearance, differ widely from the rest. At a short distance below the top the branches are, as it were, strewn over with numbers of cells, forming a superficial layer, and giving them a rough and warty appearance. These cells are distributed without any regularity over the surface; they are raised, prominent, ventricose, with thickened walls, and a single row of marginal punctures. They extend from a little below the extremities; over the whole of the lower portions of the zoarium.

The young cells have a plain semicircular mouth; and the formation of the raised secondary orifice, which bears the avicularium on its lower margin, may be traced in almost any colony. A smooth space may be noticed

extending for a short distance below the primary opening ; and around this and the original mouth the cell-wall is gradually elevated, forming the elongate and somewhat horseshoe-shaped orifice of the adult cell.

In some cases the zoëcia towards the upper portion of the branches are deeply immersed, and covered with a considerable thickness of stony crust, the original mouth and avicularium are sunk below the surface, and the actual orifice is orbicular, contracted below into a narrow, pointed sinus (Plate XLV. fig. 6). Such cells are flat, strongly punctured round the edge and sometimes over the whole of the front surface. Peach's *Eschara stellata* was probably founded on a specimen in this condition.

HABITAT. On stones and rocks in deep water.

LOCALITIES. Cornwall, common (Borlase, Couch) : Devonshire (Dr. Coldstream) : Embleton Bay, deep water (R. Embleton) : Fifeshire coast, rare (Goodsir) : Shetland (Jameson) : *ibid.*, 40–170 fathoms ; the Minch (A. M. N.) : Nymph Bank, abundant (R. Ball) : Roundstone Bay ; off the Gobbins, co. Antrim (M'Calla) : Belfast Bay (W. T.) : Youghal (Miss Ball).

GEOGRAPHICAL DISTRIBUTION. West coast of Norway ; Finmark, 30–50 fathoms (Sars) : Bahusia (Lovén) : Spitzbergen (Swed. Exped.) : Greenland (Möller and Torell) : Nova Zembla (West), 30–60 fathoms ; Kara Sea (Stuxberg and Théel) : Roscoff, common (Joliet).

The synonymy of this species has been hopelessly confused by our systematic writers ; and it bears a name in their works to which it has no legitimate claim*. Mr.

* An exception must be made in Dr. Johnston's favour, who clearly distinguished it from M.-Edwards's *Eschara cervicornis* (which is totally distinct and a Mediterranean form), and who had an excuse for giving it the same specific name as the latter, inasmuch as he referred it to another genus (*Cellepora*).

Alder, indeed, did good service by pointing out the distinction between our British form and that which Pallas and Milne-Edwards had described as *Millepora* (or *Eschara*) *cervicornis*; but he retained Pallas's name for the former, and it still holds its place. Sowerby's name *compressa*, though it has never come into use, seems to have the best claim to supersede it, and is sufficiently expressive; and I have therefore adopted it.

d. *Zoarium erect, branches cylindrical.*

PORELLA LÆVIS, Fleming.

Plate XLVII. figs. 10, 11.

CELLEPORA LÆVIS, *Fleming*, B. A. 532: *Johnst. B. Z.* ed. 2, 299.

ESCHARA TERES, *Busk*, Ann. N. H. ser. 2, xviii. 33, pl. i. fig. 2.

ESCHARA LÆVIS, *Sars*, Beskr. over Norske Polyz., Förh. Vid.-Selsk. Christiania, 1862, 150 (12 sep.): *Alder*, Quart. Journ. Micr. Sc. (n. s.) iv. 102, pl. iii. figs. 8-11 (8 sep.): *Smitt*, Cefv. Kongl. Vet.-Ak. Förh. 1878, 23.

PORELLA LÆVIS, *Escharæ* (auctt.) forma, *Smitt*, Cefv. K. Vet.-Ak. Förh. 1867, Bihang, 21 and 134, pl. xxvi. figs. 120-123.

Zoarium yellowish, much branched dichotomously; stem short, cylindrical, rising from an incrusting base; branches elongated, cylindrical, spreading, subdivided dichotomously into numerous short segments with a blunt extremity; the lower portions of the zoarium smooth and polished. *Zoæcia* immersed, flattish, ovate, with a line of large punctures round the edge, surface very minutely granulated; orifice somewhat longer than broad, arched above, slightly contracted a little above the lower margin, which is straight and bears an *avicularium* with semicircular mandible. *Oæcium* large, prominent, globose, the peristome slightly elevated in front of it.

Height of a very fine specimen from Shetland $1\frac{1}{4}$ inch, breadth $1\frac{1}{2}$ inch.

HABITAT. On corals &c., chiefly in very deep water.

LOCALITIES. Shetland (Fleming and Barlee): 20–25 miles N. and N.N.E. of Unst, in 100–170 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. West and north coasts of Norway, tolerably abundant, 30–150 fathoms, often on *Oculina prolifera* (Sars): “extra Norvegiam *Oculinæ* affixam ex abyssso,” 200–300 fathoms (Baron Ugglæ): Greenland, a specimen in the Copenhagen Museum (*teste* Smitt): Nova Zembla, Matotschkin-scharr, in Beluscha Bay, 30–70 fathoms; Kara Sea (Stuxberg and Théel).

When finely developed, *P. lævis* has a rather broad shrubby growth, the principal shoots, which are much elongated, dividing into very numerous dichotomous branchlets. One of its most striking characteristics is the smooth and polished surface, which extends over the whole of the lower part of the zoarium. The cell-apertures are only met with in any number on the upper portion of the branches; below they seem to be almost obliterated by a varnish-like coating. The walls over the whole zoarium are thick and dense, and the apertures are generally deeply sunk, while in the lower part of it the calcification seems to have proceeded so far as to remove all traces of the cell. The zoœcia are immersed, except towards the extremities of the branches, where they are somewhat prominent; the marginal punctures are hardly distinguishable in the older cells. In young cells a line of punctures is sometimes present, running across the front, a little below the mouth. The orifice is rather large, well arched above, and contracted a little below the middle, where

there is a slight projection on each side, so that it is, as Sars has remarked, somewhat lyre-shaped. The ovicells are large and very prominent, closely united to the wall of the cell above, and in front to the peristome, which forms a thin raised border round the orifice.

On the British coasts *C. lævis* has only occurred in Shetland, and ranges thence to the Arctic seas.

It was first noticed and briefly characterized by Fleming (1828), and was then almost lost sight of until it was redescribed by Sars (1862) and subsequently by Alder.

Genus ESCHAROIDES *, *Smitt*.

Der. Formed from *Eschara*, a genus of Polyzoa.

ESCHARA (part.), auctt.

GENERIC CHARACTER.—ZOECEIA with the primary orifice suborbicular; peristome much elevated and forming a secondary orifice, arched above and with a sinus below, within which an avicularium is inclosed. ZOARIUM (in British species) erect, ramose.

ESCHAROIDES ROSACEA, Busk.

Plate XLVII. figs. 5–9.

ESCHARA ROSACEA, *Busk*, Ann. N. H. ser. 2, xviii. 33, pl. i. fig. 4: *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 9, pl. vi. figs. 10–12.

ESCHAROIDES ROSACEA, *Smitt*, Öfv. K. Vet.-Ak. Förh. 1867, Bihang, 25 and 161, pl. xxvi. figs. 155–159.

Zoarium composed of a short stem and a number of compressed foliaceous branches, divided into shallow dilated

* The name originated with Milne-Edwards.

lobes, and more or less curved or contorted; white or of a delicate rose-colour. *Zoæcia* ovate, slightly convex, walls thick and dense, surface granulated; primary orifice simple, semielliptical, on a level with the surface of the zoarium; secondary aperture arched above, with a rather deep and narrow sinus on the lower margin, immersed; an *avicularium* on one side of the sinus, with a semicircular mandible. *Oæcia* hemispherical, granulated.

Height from $\frac{1}{2}$ to $\frac{3}{4}$ inch.

HABITAT. On stones and shells &c., from moderate depths to deep water.

LOCALITIES. Loch Fyne, on *Pecten opercularis* (A. M. N.): Orkney (Busk): off Shetland, 80–100 fathoms (J. Gwyn Jeffreys, *vide* Peach).

GEOGRAPHICAL DISTRIBUTION. Finmark, on *Balanus*, *Rhynchonella*, *Ptilota plumosa* (Lovén): Spitzbergen, 20 fathoms (Malmgren): Norway (M'Andrew): St. George's Bank, lat. $42^{\circ} 56' 5''$ N., long. $64^{\circ} 51' 3''$ W. (Smith and Harger).

E. rosacea is generally of small size, not much exceeding half an inch in height, and possesses a very characteristic habit. A short stem rises from a small incrusting mass of cells; and this divides irregularly into a number of foliaceous, flattened, rather thick branches, variously curved and twisted, and terminating above in short lobes, which expand towards their extremity. Young specimens consist of a simple expansion cleft above into two lobes, and are very delicately tinted. Possibly the colour may be dependent on age. Smitt describes his Norwegian specimens as glossy white.

The cells are very slightly convex; and the boundaries between them are almost obliterated in the older portions of the colony by the great overgrowth of calcareous

matter. At the extremity of the branches they are somewhat prominent, regularly oval and distinctly separated. In this portion of the zoarium we find the primary orifice, which is perfectly simple, without any trace of sinus and on a level with the surface, instead of being, as it is in later stages of growth, deeply immersed. The characteristic aperture of the species, with the marginal sinus, is altogether a secondary formation, which is developed as calcification proceeds. The avicularium is connected with the secondary orifice, and in the first instance is placed on the surface, outside it and slightly overhanging it, close to the sinus*. But ultimately it is inclosed by the accretion of stony matter on the front of the cell, and lies completely within the wall which has grown up around the mouth. The various stages in this curious history may be traced amongst the cells occupying the tips or growing portions of the branches †.

A striking feature of the species is the degree in which the walls of the zoecia are thickened by the accretion of calcareous matter, and the (apparent) rapidity with which the process goes on. As a consequence the build of the adult zoarium is solid and massive.

In some cases numerous circular avicularia are distributed irregularly over the cells, at times slightly elevated, at times subimmersed. In the latter condition they are no doubt being enveloped by the calcareous crust, and would probably have disappeared altogether after a time. I believe that in other instances the non-occurrence of these organs, where they are usually present, may be due to a similar cause.

* It is so represented in Alder's figures of the cells accompanying Norman's description of the species (*Quart. Journ. Micr. Sc. l. c.* pl. vi. figs. 11, 12). These figures are taken from cells in which the secondary orifice has been recently developed.

† They have been accurately described by Smitt (*l. c.*).

ESCHAROIDES QUINCUNCIALIS, Norman.

Plate XV. fig. 7.

ESCHARA QUINCUNCIALIS, *Norman*, Hebridean Polyz., Rep. Brit. Assoc. for 1866 (1867), 204; Quart. Journ. Micr. Sc. (n. s.) viii. 10, pl. vii. figs. 1-3.

Zoarium cylindrical, smooth, polished. *Zoæcia* in linear series, disposed quincuncially round an imaginary axis, almost confluent, flat or slightly depressed below, the oral region mammæform; orifice (adult) rounded above, usually with a sinus, placed towards one side on its lower margin, and a small and inconspicuous *avicularium* close to it; the peristome raised and thickened. *Oæcia* rounded, subimmersed, with an arched space in front, filled in by less highly calcified material, and sometimes perforated, closely united to the raised peristome, and forming with it elongated mamillary risings on the upper portion of the cell.

LOCALITY. Dredged in deep water in the Minch (A. M. N.).

The specific character is founded on the fragment, "not more than a quarter of an inch long," which was obtained in the Hebrides by Messrs. Jeffreys and Norman. So minute a specimen does not afford the means of studying the various stages in the development of the zoæcium; and the diagnosis must be accepted subject to any corrections which a more thorough study of the species may supply. An examination of the few marginal cells available for the purpose shows that, in the earlier stages of growth, the minute *avicularium* is borne on a short rostriform elevation, placed a little towards one side of the primary aperture. At this point the raised and thickened peristome, which is so marked a characteristic of the adult, is not formed; when developed it seems to

inclose the rostrum, which is now within the (secondary) aperture. The cells are disposed in longitudinal lines ; and each series alternates with the next ; so that the plan of arrangement over the surface of the zoarium is quincuncial. They are divided by a very slight depression, and have almost the appearance of being confluent. The surface is flattish ; and the raised and somewhat swollen and massive peristome, with the ovicell to which it is united, forms a rather large ovoid mamillary rising at the top of each cell. This is the most striking feature of the species. The ovicell is small and subimmersed ; and there is always on the front of it a depressed area, which is arched above, and filled in by some slighter and probably membrano-calcareous material. The surface of the zoarium is perfectly smooth, entire, and glossy.

Genus SMITTIA, *Hincks*.

Der. Named in honour of Prof. F. A. Smitt.

ESCHARA (part.), auctt.

BERENICEA (part.), Johnston.

LEPRALIA (part.), Johnston : Busk : &c.

ESCHARELLA, Smitt (as limited in his paper on Bryozoa from Nova Zembla, Cf. K. Vet.-Ak. Förh. 1878 : not *Escharella* of Gray or D'Orbigny).

SMITTIA, *Hincks*, Ann. N. H. February 1879.

GENERIC CHARACTER.—ZOECIA *with the primary orifice suborbicular, the lower margin entire and dentate ; peristome elevated and forming a secondary orifice, which is channelled in front ; generally an avicularium below the sinus. ZOARIUM (in British species) either incrusting, or erect and foliaceous, the cells in a single or double layer.*

FOR this very natural and well-defined group Smitt has

adopted the name *Escharella*, first introduced by Gray, and afterwards employed in a totally different sense by D'Orbigny, for a form which he made the type of a family, the *Escharellidæ*. Smitt himself has not been very constant in his mode of applying the name, having first given it to a somewhat heterogeneous collection of species and afterwards to a mere section of it.

It seems undesirable that terms which have been thus bandied about until they have been emptied of all fixed meaning should be retained; and I have great pleasure in substituting for this questionable name another which commemorates one of the most able workers in this department of zoology.

The cardinal character of this genus is the elevated secondary orifice, produced and channelled in front. The dentate lower margin is common to it and the following genera. They also agree in having a raised peristome, though in the present group it forms a perfect secondary mouth; whilst in *Phylactella* it only incloses the primary opening in front and at the sides, and in *Mucronella* takes the form of a mucronate process on the lower lip.

SMITTIA LANDSBOROVII, Johnston.

Plate XLVIII. figs. 6-9.

LEPRALIA LANDSBOROVII, *Johnst. B. Z.* ed. 2, 310, pl. liv. fig. 9: *Busk, B.M. Cat.* ii. 66, pl. lxxxvi. fig. 1, and pl. cii. fig. 1 (referred to *L. reticulata*); *Hincks, Quart. Journ. Micr. Sc.* viii. 277; *Devon Cat., Ann. N. H.* ser. 3. ix. 200 (40 sep.).

ESCHARA LANDSBOROVII, *Alder, Quart. Journ. Micr. Sc.* n. s. iv. 105, pl. iv. figs. 1-3.

ESCHARA FOLIACEA, var., *Alder, North. Cat., Trans. Tynes. F. C.* iii. 151.

LEPRALIA CRYSTALLINA, *Norman, Rep. Brit. Assoc.* 1866, 204.

ESCHARELLA LANDSBOROVII (part.), *Smitt, Cefv. K. Vet.-Ak. Förh.* 1867,

Bihang, 12 and 92, pl. xxiv. fig. 63; Floridan Bryoz. pt. ii. 60, pl. x. figs. 201, 202*.

? *ESCHARELLA PORIFERA*, *Smitt*, forma MINUSCULA and forma MAJUSCULA, l. c. Krit. Förteckn. 9, 73, and 74, pl. xxiv. figs. 33-35 and 36-38.
ESCHARELLA PERTUSA, *Smitt* (= *E. porifera*), Öfv. K. Vetensk.-Ak. Förh. 1878, no. 3, 21.

Zoæcia ovate or rhombic, or elongate and somewhat rectangular, in linear series, alternate, separated by raised lines; walls thin and glassy, punctured round the margin or over the entire surface; primary orifice suborbicular, or slightly subquadrangular, a prominent tooth within the lower margin, and a minute denticle on each side of it; peristome raised, especially in the fertile cells, thin, cleft in front into a narrow, spout-like sinus, partially inclosing a small rounded *avicularium*; below it usually a mamillary rising. *Oæcia* globose or ovate, prominent, punctured, frequently a large, raised, spatulate *avicularium* placed transversely on each side or on one only.

Colonies spreading in large subcircular patches, silvery when fresh, and often of a reddish colour; or rising into thin foliaceous expansions, "anastomosing irregularly, and undulated on the margin."

The erect form attains a height of 2 inches.

Form *a* (*crystallina*, Norman) (Plate XXXVI. fig. 2).

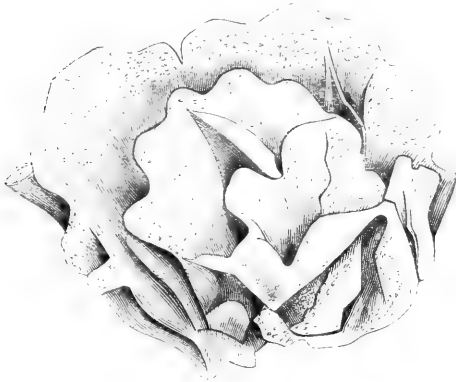
Zoæcia small, lozenge-shaped, rather convex, not very regularly arranged, surrounded by inconspicuous lines, white and silvery, surface covered throughout with round punctures; orifice (secondary) triangular, peristome much raised at the sides, in front deeply cleft into a channelled sinus, and immediately below it a small *avicularium*, with rounded mandible, pointing downwards; oral spines five (rarely present); a central tooth on the lower (primary) margin and two lateral denticles. *Oæcia* globose, prominent, punctured.

Colonies forming small silvery-white patches.

* Of *Smitt's* figures of *Escharella Landsborovii* in his 'Catalogue,' only one (fig. 63) seems to me referable to the present species.

Form β (? *porifera*, Smitt). *Zoæcia* short-ovate or rhombic, flattish, very thickly punctured over the entire surface; orifice (secondary) suborbicular, with two minute lateral denticles; central tooth wanting; peristome very slightly elevated; suboral *avicularium* subcircular or oval. *Oæcia* rounded, not hooded, obscurely punctured; spatulate *avicularia* none (?). (Plate. XXXVI. fig. 1.)

Fig. 15.

*Smittia Landsborovii.*

RANGE OF VARIATION. The cell in the typical form is usually elongate, often somewhat rectangular, with a flattish surface and thin walls; but it is also not unfrequently, within the limits of one and the same colony, short and ovate, or rhomboid. The peristome is more or less developed: sometimes it forms an elevated wall round the mouth, which is cleft in front into a very deep fissure or sinus; in other cases it is very slightly raised. These differences affect the form of the secondary orifice.

The primary aperture is to some extent subquadrangular ("rotundato-quadrangularis"); the secondary orifice,

formed by the elevation of the peristome, is more or less triangular, or (occasionally) almost orbicular. The cell-wall is either punctured round the margin only, the central portion remaining entire, or is thickly covered over the whole extent with circular pores. The median avicularium seems to be constant; but the large spatulate form is in most cases rarely developed, and always in connexion with the ovicell.

The differences in the mode of growth are similar to those which we find in *Lepralia foliacea* and other species. The crustaceous habit seems to be the prevalent one. On the south-western coasts, where *S. Landsborovii* is abundant, I have never met with it in the erect foliaceous state; but in certain localities it rises into free lamellate fronds, which anastomose and form coral-like masses (woodcut, fig. 15). It assumes both the Escharine and Hemescharine habit; and under the older system of classification three genera would have about an equal right to claim it.

These are the chief variations to which the species is liable, apart from the superficial changes dependent on age and locality.

Lepralia crystallina, Norman, is a small and very delicate variety of the present species, distinguished by its highly developed peristome and produced triangular secondary orifice, and by its bright and hyaline appearance. It is a deep-water form.

The variety *porifera*, Smitt, is characterized by its short ovate cell with a thickly punctured surface, its slightly developed peristome, and suborbicular secondary orifice, and by the total absence of the central tooth. The ovicell also seems to be smaller than that of the normal *S. Landsborovii*; and the spatulate avicularia are, I believe, always wanting. Smitt, in his latest paper

(on *Polyzoa* from Nova Zembla), identifies his *Escharella porifera* with *Lepralia pertusa*, Busk; but the latter, which seems to be little known in the North, is certainly referable to another group.

I have had much difficulty in unravelling the synonymy of this species, and suspect that the Scandinavian naturalists have associated with it some northern varieties which are not known on our coasts. I should refer all the forms assigned by Smitt to his *E. porifera* to *S. Landsborovii*, with the exception of those represented in his plate xxiv. figs. 40, 41, which I cannot identify, and the one which he names forma *edentata*. This seems to be a distinct species; and I have elsewhere characterized it as *Lepralia reticulato-punctata*.

HABITAT. On shells, stones, &c., from moderate depths to deep water.

LOCALITIES. South Devon; Cornwall, 30 fathoms, on *Sertularia abietina*; off the Great Orme's Head (the erect form); Guernsey (T. H.): Hastings (Miss Jelly): Scarborough (Bean): north coast of Northumberland, erect (Embleton): Ayrshire (D. L.): Peterhead, rare (C. W. P.): Shetland, very rare; the Lepralian state on a stone from 170 fathoms (A. M. N.): Antrim (Hyndman): Birterbuy Bay (G. S. B.). Var. *porifera*. South Devon (T. H.). Var. *crystallina*. The Minch; Shetland, 80–140 fathoms (A. M. N.): off the coast of Antrim (Hyndman).

GEOGRAPHICAL DISTRIBUTION. Durban, Natal, on oyster shells (W. Oates): Australia (T. H.)*: Florida, 176 fathoms (Pourtales): Greenland (North-German Pol. Exped.): Arctic Seas (Smitt). Var. *porifera*. Davis Strait, off Frederickshaab, 100 fathoms (Wallich). Var.

* In the Australian specimen, which I have examined, the cells are ovate, lined round, thickly punctured over the entire surface, and with three or four marginal spines.

crystallina. Greenland, lat. $66^{\circ} 59' N.$, long. $55^{\circ} 27' W.$, 57 fathoms ('Valorous' dredgings) : Bergen (A. M. N).

RANGE IN TIME. Var. *crystallina*, Scotch Glacial deposits (Geikie).

SMITTIA RETICULATA, J. Macgillivray.

Plate XLVIII. figs. 1-5.

LEPRALIA RETICULATA, *Macgill. Ann. N. H.* ix. 467 : *Johnst. Br. Z.* ed. 2, 317, pl. lv. fig. 10 : *Busk, B.M. Cat.* ii. 66, pl. xc. fig. 1, and xcii. figs. 1, 2 (not pl. cii. fig. 1).

ESCHARINA RIMULATA, *D'Orb. Voy. d. l'Amér. mér. Polypiers*, 15, pl. vii. figs. 1-4 (fide *Smitt*).

REPTESCHARELLA RIMULATA, *id. Pal. franç. terr. crét.* v. 465.

ESCHARELLA LEGENTILII * forma TYPICA, *Smitt, Cefvers. K. Vet.-Akad. Förh.* 1867, Bihang, 10 and 81, pl. xxiv. figs. 50-52.

Zoæcia ovate-elongate, in linear series, separated by raised lines, punctured or strongly areolated round the margin, smooth or slightly roughened, and somewhat raised in the centre; orifice orbicular, with a thin raised margin and a deeply channelled sinus in the lower lip, three denticles within, the central one the largest; immediately below the sinus a large *avicularium*, with acute mandible pointing downwards, sometimes projecting and sometimes immersed; marginal spines three. *Oæcia* semicircular or globose, prominent, punctured, the elevated peristome in front giving them a hooded appearance.

Colonies spreading irregularly, and often of considerable size, silvery and bright when fresh.

The *primary cell* seems only to differ from the rest in size.

RANGE OF VARIATION. *S. reticulata* exhibits many diffe-

* I do not follow Smitt in adopting Audouin's name, because it seems to me impossible to say with any certainty that Savigny's figure represents the present species, and there is no description to appeal to.

rences of appearance, dependent upon age, locality, &c.; but there is very little variability in important characters. Sometimes the zoëcia are margined by a row of circular pores; sometimes they are very prettily areolated round the edge*.

Commonly the avicularia are elevated, and project in front of the lower lip; but in one of the best-marked varieties they are immersed and of smaller size than usual, the cells are flat, punctured round the sides, and of dense texture; the margin of the orifice is but slightly raised; and the oëcium is closely united to the cell above, and not so prominent as in the common form (Plate XLVIII. fig. 2).

A curious monstrosity has occurred to me, in which two cells have but a single ovicell between them, which is of great breadth, and overarches the two openings. The cells are somewhat narrowed; and the avicularia are turned a little to one side (Plate XLVIII. fig. 3).

HABITAT. On shells, stones, corals, &c., chiefly from deep water.

LOCALITIES. Guernsey; South Devon; Cornwall, especially on *Pinnæ*, from 40–60 fathoms (T. H.) †: Norfolk (Lieut. Thomas): Northumberland, on shells from deep water, not rare (Alder): Aberdeen (Macgillivray): St. Andrews, not uncommon in the siphons and inside the mouth of *Fusus antiquus*, and on *Cardium*, from deep water (Dr. M'Intosh): Loch Fyne (Lady Emma Campbell): Wick and Peterhead (C. W. P.): Shetland, rare, 80 fathoms (A. M. N.): Belfast Bay, deep water (W. T.):

* This difference is probably dependent upon age. The youngest cells are perfectly smooth, the walls extremely thin, and perforated round the edge by a number of circular pores.

† One of the most abundant species on the Cornish *Pinnæ*, from 60 fathoms, forming exquisite patches on the interior surface of the shell.

coast of Antrim, 47 fathoms (Swanston) : Birterbuy Bay (A. M. N.) : &c.

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet) : Charente-Inférieure (Fischer) : Ægean Sea (E. Forbes) : Adriatic (Heller) : Bergen (A. M. N.) : Bahusia and Southern Norway, chiefly in great depths, 200–300 fathoms ; in moderate depths rather rare (Smitt) : Falkland Islands (D'Orbigny) : New Zealand (F. W. Hutton).

SMITTIA AFFINIS, Hincks.

Plate XLIX. figs. 10, 11.

LEPRALIA AFFINIS, *Hincks*, Devon and Cornw. Cat., Ann. N. H. ser. 3, ix. 206, pl. xii. fig. 2 (46 sep.).

Zoæcia broad-ovate, distinct, moderately convex, separated by lines ; surface smooth (in the young cells), minutely punctured ; orifice orbicular, with a thin, raised peristome, channelled in front, three denticles within, the central one the largest ; immediately below the inferior margin, to which it is attached, an *avicularium*, placed more or less transversely, with pointed mandible. *Oæcia* unknown.

Colony forming a circular patch.

HABITAT. On shell.

LOCALITY. Start Bay, South Devon (T. H.).

As only a single specimen has occurred, it is impossible to decide how far this is a permanent, well-established form. Its nearest ally is *S. reticulata*, from which it is distinguished chiefly by the position of the avicularium, which, instead of projecting longitudinally below the orifice, and pointing straight downwards, is placed trans-

versely, or somewhat obliquely across, in front of the lower margin, to which it is attached. It is so placed as to fill up the sinus in the peristome; in front it is tilted up, and the mandible is pointed obliquely towards the side.

S. affinis also differs from *S. reticulata* in having a broader and shorter and less convex cell, and in having the whole surface rather thickly punctured. It may possibly be an abnormal condition of the last-named species; but looking to the marked difference in the general character of the zoëcia, and the very peculiar position of the avicularium, which is constant over the whole colony in the only specimen that has come under my notice, I am inclined to give it provisionally specific rank.

In support of this view it may be remarked that the position of the avicularium in *S. reticulata* is not liable to variation as it is in some species. On the contrary, it is remarkably constant, and I do not remember to have seen any approach to the peculiarity which distinguishes the present species.

SMITTIA CHEILOSTOMA, Manzoni.

Plate XLII. figs. 7, 8.

LEPRALIA CHEILOSTOMA, *Manzoni*, Bryoz. foss. Ital., Contrib. 3, 13, pl. iv. fig. 22 (Sitzb. k. Akad. d. Wissensch. 1. Abth. Dec.-Heft, 1869).

Zoëcia ovate or rhombic, very slightly convex, usually separated by raised lines, quincuncially disposed, the series radiating from a common centre; surface covered with punctures; orifice (primary) suborbicular, with a hammer-shaped denticle on the lower margin, surrounded by a much raised peristome, with a deep cleft or sinus in front; *avicularia* none. *Oæcia* de-

pressed, closely united to the cell above, rounded, slightly elongated transversely (almost semicircular), punctured, with a subgranular border round the base. Colonies forming subcircular patches of a deep red colour.

HABITAT. On shells, stones, &c., from shallow to deep water (60 fathoms).

LOCALITIES. Guernsey, abundant; South Devon; Cornwall, deep water (T. H.): Hastings (Miss Jelly): west coast of Ireland (A. M. N.).

RANGE IN TIME. Italian Pliocene (Manzoni).

In this species the peristome is much elevated, and the secondary orifice is suborbicular above, slightly compressed or flattened at the top, and below is produced into a deep notch or sinus. The surface is uniformly and thickly punctured. The ovicell is generally much depressed, and is inclosed round the edge by a narrow belt of granular crust. The peristome is carried across the front of it.

When young the cells are semitransparent and glossy; but with age the zoarium becomes coarse in appearance, and of a dull whitish colour.

A variety occurs of delicate texture, and with very minute puncta; but otherwise the species is very constant in character.

SMITTIA MARMOREA, Hincks.

Plate XXXVI. figs. 3-5.

LEPRALIA MARMOREA, Hincks, Ann. N. H. Sept. 1877, 214.

Zoæcia ovate, short and rather broad, somewhat elevated towards the mouth, disposed in lines, with a row of

rather large punctures round the border ; surface coarsely granular ; orifice suborbicular, with a loop-like sinus on the lower margin ; peristome raised, not thickened, a very broad plate or denticle set deeply within the mouth ; a little below the orifice an elongate *avicularium*, usually immersed, with a pointed mandible directed downwards. *Oœcia* globose, punctured, immersed in the older cells, with a narrow raised border round the base.

HABITAT. On stone and shells.

LOCALITIES. Cornwall, probably (T. H.) : Guernsey (A. M. N.)

The walls of the cells are thick ; and the surface, which is covered with large granules, has a somewhat polished and marble-like appearance. The cells are moderately convex, elevated towards the mouth, and regularly punctured round the margin. The peristome is raised, especially in front, where it is hollowed into a rather large loop-like sinus. The *avicularium* is immersed and inconspicuous ; it is occasionally absent. The young cells are perfectly smooth, and with the surface entire.

S. marmorea and *S. cheilostoma* are kindred forms, having many features in common, but still exhibiting differences of such a kind as entitle them to be accounted distinct. In the former the cell-wall seems never to be punctured, except round the margin, where there is a very conspicuous line of perforations : the surface is coarsely granular ; in *S. cheilostoma* it is uniformly covered with pores over its entire extent, and there is no special row of them round the edge. The cell of *S. marmorea* in its earliest stages is destitute of punctures ; so that the difference between the two forms in this respect is not due to mere age and calcification. In the latter the wall of

the cell rises markedly towards the mouth, and the front of the peristome is thus elevated, while the upper margin appears depressed. In *S. cheilostoma* the surface is level and uniform, and the margin as much elevated above as in front. That species is always destitute of avicularia; whilst in *S. marmorea* there is usually one below the orifice, occupying much the same position as in *S. reticulata*. There are also differences in the denticle on the lower margin, which in the present species assumes the form of a very broad plate. *S. marmorea*, so far as I know, is destitute of the deep-red colour which is so characteristic of its ally.

Apart from these divergences, which in the aggregate are not unimportant, there is a difference in general appearance which can hardly be formulated.

I have only seen a few specimens of *S. marmorea*; and possibly a larger series might show an intermingling of characters; but at present I hold the two forms to be distinct.

SMITTIA BELLA, Busk.

Plate XLII. figs. 9, 10.

LEPRALIA BELLA, Busk, Quart. Journ. Micr. Sc. viii. (1860), 144, pl. xxvii. fig. 2 (not *L. bella*, Norman, Shetland Polyz., Rep. Brit. Assoc. 1868, 306, which is a var. of *Porella concinna*).

Zoæcia ovate, punctured; aperture orbicular, with a spout-like sinus below, and within it a large bifid denticle; peristome raised, often thickened. *Oæcia* subglobose, punctured.

HABITAT. On shells.

LOCALITY. Shetland (Barlee).

I only know this species from Busk's description and figures, and can add nothing to them. It seems to be nearly related to *S. cheilostoma*.

SMITTIA TRISPINOSA, Johnston.

Plate XLIX. figs. 1-8.

DISCOPORA TRISPINOSA, *Johnst.* Ed. Phil. Journ. xiii. 322.

BERENICEA TRISPINOSA, *id.* Trans. Newc. Soc. ii. 268.

LEPRALIA TRISPINOSA, *id.* B. Z. ed. 2, 324, pl. lvii. fig. 7: *Busk*, B.M. Cat. ii. 70, pl. lxxv. figs. 1, 2, pl. xeviii., pl. cii. fig. 2: *Hincks*, Greenland Polyz., Ann. N. H. Jan. 1877, 100, pl. xi. fig. 1.

LEPRALIA VARIOLOSA, var. *a*, *Johnst.* B. Z. ed. 2, 317, pl. lv. fig. 8.

ESCHARELLA JACOTINI, *Smitt*, forma LAMELLOSA, and forma TYPICA, loc. cit. Krit. Fört. iv. 11 & 86, pl. xxiv. figs. 53-57.

?ESCHARELLA JACOTINI, *Smitt*, Flor. Bryoz. pt. ii. 59, pl. x. fig. 199.

LEPRALIA JEFFREYSI (=var. *a*), *Norman*, Prelim. Rep. 'Valorous' Cruise, Proc. Roy. Soc. no. 173 (1876), 208.

Zoëcia ovate or elongate-ovate, sometimes almost rectangular, disposed in linear series or quincuncially, subgranular, separated by raised lines, and punctured round the edge; orifice suborbicular; peristome thin, more or less raised, usually produced in front into a spout-like sinus, a denticle within the lower margin; oral spines 2-4; frequently a large *avicularium* on one side, a little below the orifice, mandible acute and (usually) directed upwards; occasionally a smaller oval *avicularium*, on one or both sides of the orifice, with rounded mandible, pointing downwards. *Oæcia* ample, globose, united to the cell above, somewhat flattened in front, usually with two or three large pyriform punctures.

Colonies forming large yellow crusts.

Var. *a* (*Jeffreysi*, *Norman*). *Zoëcia* rectangular, smooth or subgranular, surface much depressed; peristome not raised, denticle very conspicuous; oval *avicularia* irregularly distributed over the surface, sometimes numerous; pointed *avicularia* often rare, and of small size.

RANGE OF VARIATION. Specimens of this species exhibit very striking diversities in appearance; and there is also a considerable amount of variability in certain characters. The zoœcia present two very distinct shapes, being in some cases ovate and moderately convex, in others rectangular, with a flat surface. The orifice wears a very different appearance according to the degree in which the peristome is developed. In the young cell it is not at all elevated; the mouth is a simple, suborbicular opening, with a flat rim, arched above, almost straight below, and slightly compressed laterally. In this condition, which seems to be permanent in the Arctic variety *a*, the denticle on the lower lip is a conspicuous feature. Usually the peristome rises in the adult cell and forms a thin wall round the mouth, which is prolonged in front into a kind of spout. In the fertile cells, this raised border is much developed; and in some cases it forms a continuous ring round the mouth, in front of the ovicell. The oral spines vary in number from two to four.

As usual, the avicularium is the most inconstant member of the colony. It presents itself under two forms: one of these (and the only one which has been noticed by previous writers) is of large size, at times gigantic, elongate, with a triangular mandible; the other is much smaller, oval, with a rounded mandible. In their position and direction there is no constancy; but the larger form seems to be most commonly placed close to the mouth, on one side of the central sinus, with the mandible directed upwards, while the smaller is usually developed near the top of the cell, on one side of the mouth, or on both sides, with the mandible pointing downwards; but the exceptions are numerous. The large avicularia, which are often wanting altogether, are generally single; but sometimes two occur on the same cell, in very variable positions.

The small oval avicularia are equally inconstant, and are often distributed irregularly over the surface of the cells. There is sometimes an amazing profusion of them.

When very old, the walls of the cells are much thickened, overlaid with a dense crust, and coarsely granulated; and in this condition some of the familiar features of the species are almost obliterated.

HABITAT. On stones, shells, &c., from shallow water to great depths.

LOCALITIES. One of the commonest of our British species. Cornwall, 60 fathoms, incrusting *Pinnæ*; S. Devon, very common; Isle of Man; Guernsey, in large masses on shell (T. H.): Hastings (Miss Jelly): Berwick, deep water (Johnst.): St. Andrews (Dr. M'Intosh): Hebrides; Shetland, 170 fathoms (Norman): Birterbuy Bay (G. S. Brady): &c. Var. *a.* Dogger Bank (T. H.).

GEOGRAPHICAL DISTRIBUTION. Norway (Lilljeborg): Bahusia, shells, in great depths (Lovén): Arctic regions, on *Rhynchonella* (Torell): Nova Zembla (west), 30–60 fathoms; Kara sea (Stuxberg & Théel): Gaspé, Gulf of St. Lawrence, about 30 fathoms (Dawson): Anticosti and Mingan Islands (Packard): Mazatlan (P. P. Carpenter): Florida (Pourtales): Cape Horn, 40 fathoms (Darwin): Aden (W. Oates): Adriatic (Grube). Var. *a.* Greenland, lat. $69^{\circ} 31' N.$, long. $56^{\circ} 1' W.$, 100 fathoms ('Valorous' dredgings): off Frederickshaab, Davis Straits, 100 fathoms; Reykjavik Harbour, 15–20 fms. (Wallich).

RANGE IN TIME. Postpliocene, Canada (Dawson).

I do not follow Prof. Smitt in substituting Audouin's specific designation for Johnston's well-known name. Such a course does not seem to be called for by a regard to scientific law, nor would it promote scientific interests. Savigny's figure may possibly be intended as a represen-

tation of the present species ; but it is so entirely wanting in character, and fails so completely to give the striking features of *S. trispinosa*, that it is practically useless for the purpose of identification ; and as it is unaccompanied by a diagnosis, I am unable to see that it gives any claim to the name with which it is associated.

Genus PHYLACTELLA, *Hincks*.

Der. From φυλακτὸς, fortified.

LEPRALIA (part.), auctt.

ALYSIDOTA (sp.), Busk.

GENERIC CHARACTER.—ZOECIA *with the primary orifice more or less semicircular, the lower margin usually dentate ; peristome much elevated, not produced or channelled in front. No* AVICULARIA. ZOARIUM (*in British species*) *incrusting.*

THIS genus is instituted for two or three species which seem to lie outside the preceding, though nearly related to it. *P. labrosa*, with its triplet of denticles, its elevated peristome, and its porous surface, exhibits much affinity with such forms as *S. Landsborovii*. *P. eximia* agrees with it in most points ; but the pores are only present round the margin. In *P. collaris* both pores and denticles have disappeared. The chief distinction between this genus and the last lies in the character of its raised peristome, which in *Smittia* contracts in front into a channelled sinus, whilst in *Phylactella* it is entire. The primary orifice in the latter is almost semicircular.

PHYLACTELLA LABROSA, Busk.

Plate XLIII. figs. 1, 2.

LEPRALIA LABROSA, *Busk*, B.M. Cat. ii. 82, pl. xcii. figs. 1-3: *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 204 (44 sep.): *Norman*, Shetland Polyz., Rep. Brit. Assoc. 1868, 308.

ALYSIDOTA LABROSA, *Busk*, Crag Polyz. 26, pl. xxii. fig. 7.

PHYLACTELLA LABROSA, *Hincks*, Ann. N. H. Feb. 1879, 161.

Zoæcia ovate, distinct, disposed in lines, punctured over the entire surface; orifice almost semicircular, with a square-topped tooth on the lower margin, and on each side of it a minute, sharply-pointed denticle; peristome much elevated, thickened, expanded, forming a wall round the front and sides of the mouth. *Oæcia* small, rounded, broader than long, recumbent, punctured.

Primary cell small, ovate, perfectly smooth; aperture orbicular, with a smooth, flat border in front, and surrounded by a few rather tall and slender spines.

Colonies consisting of single or double series of cells, branching irregularly from a common centre, where a number are massed together.

HABITAT. Usually on old shells, from rather deep water.

LOCALITIES. Off the Copeland Islands, Belfast Bay, deep water (W. T.): Antrim, deep water, rather plentiful (Hyndman): Shetland, scarce, 40 fathoms (A. M. N.): Oban; South Devon, not common (T. H.): Hastings (Miss Jelly): Wick; Cornwall, off Fowey, and 5 miles off the Deadman (C. W. P.).

DISTRIBUTION IN TIME. Red Crag, on shell (Searles Wood).

There is little variability in this very pretty species; the characters are marked and stable. The surface of both the cell and ovicell is thickly and regularly punctured.

The mass of zoœcia, from which the linear series are given off, is sometimes of considerable size; in other cases branching commences at once, and the colony consists of a very small nucleus, surrounded by long, straggling lines of cells.

PHYLACTELLA COLLARIS, Norman.

Plate XLIII. fig. 3.

LEPRALIA COLLARIS, *Norman*, Rep. Brit. Assoc. 1866, 204.

PHYLACTELLA COLLARIS, *Hincks*, Ann. N. H. Feb. 1879, 161.

Zoœcia ovate, small, crowded, convex, arranged in regular radiating lines, smooth, or subgranular; orifice suborbicular, arched above, slightly truncate below; peristome elevated into a broad, frill-like border, expanded in front, which surrounds the sides and lower margin. *Oœcia* somewhat reniform, depressed, punctured.

Colonies small subcircular patches, of a brownish colour.

HABITAT. On shells, &c., from shallow to deep water.

LOCALITIES. The Minch, Hebrides; Shetland, scarce, 80–100 fathoms; Guernsey (A. M. N.): Torbay; Isle of Man (T. H.): Hastings (Miss Jelly): off the Maiden Lighthouses, Antrim, 72 fathoms (Swanston).

Nearly related to *P. labrosa*, Busk, from which it differs in the absence of the perforated cell-wall, and the triplet of marginal denticles. It also shows no tendency to the dendritic habit of growth. The cells are arranged with much regularity in linear series, which radiate from a common centre. In certain states the punctures on the ovicell are almost obliterated.

PHYLACTELLA EXIMIA, Hincks.

Plate XLIX. fig. 11.

- LEPRALIA EXIMIA, *Hincks*, Proc. Dubl. Univ. Zool. & Bot. Assoc. ii. pt. i. 75, pl. iii. figs. 3, 3 a; Quart. Journ. Micr. Sc., Zooph. viii. 276, pl. xxx. figs. 3, 3 a: *Peach*, Journ. Roy. Inst. Cornwall, no. xviii. (1876), 2 (sep.), fig. 4.
PHYLACTELLA EXIMIA, *Hincks*, Ann. N. H. Feb. 1879, 161.

Zoecia ovate, distinct, moderately convex, punctured, and with an inconspicuous line round the edge; texture dense, surface minutely granular; primary orifice almost semicircular, with a rounded tooth on the lower margin, and two small lateral denticles, surrounded, except above, by an elevated peristome, which rises on each side into a broad, somewhat triangular expansion. *Oecia* prominent, globose; surface smooth, covered with raised punctures, silvery when fresh.

Colonies growing in large spreading crusts, with a lobate margin.

HABITAT. On shell and stone from deep water.

LOCALITIES. Coast of Antrim (Hyndman): off the Deadman (C. W. P.): Shetland (A. M. N.).

The cells are large and very distinct in the Antrim specimens; the ovicells are prominent; and the mode of growth is decidedly lobulate. In the single specimen which I have seen from Shetland the granular crust seems to be more fully developed, the ovicells are subimmersed, being partially invested by it, and the sutures between the cells are less marked. The secondary mouth is somewhat quadrate in shape; and the wall-like peristome, which forms it, slopes outwards in front, and at the sides usually rises into broad expansions, pointed above, and often bending over the aperture. The marginal punctures are frequently wanting. The ovicell is very smooth and silvery, and the walls of the cell are thickly and minutely granulated.

iii. *With a mucronate peristome.*Genus MUCRONELLA, *Himcks.*Der. From *mucro*, a point.

BERENICEA (part.), Fleming.

LEPRALIA (part.), Johnston: Busk: &c.

ESCHARELLA, Gray.

DISCOPORA (part.), Smitt.

GENERIC CHARACTER.—ZOECIA *with a suborbicular or semicircular orifice; the peristome elevated in front into a more or less prominent mucro.* ZOARIUM (*in the British species*) *incrusting.*

THIS genus is equivalent in part to the *Discopora* of Smitt, but not of Fleming, who originated the name for a species belonging to a totally different section of the Polyzoa (the *Cyclostomata*), with which it is still connected in the slightly modified form *Discoporella*. In the British species the lower margin of the orifice is almost universally dentate.

a. *Without avicularia.*

MUCRONELLA PEACHII, Johnston.

Plate L. figs. 1-5, and Plate LI. figs. 1, 2.

LEPRALIA PEACHII, *Johnst. B. Z.* ed. 2, 315, pl. lv. figs. 5, 6: *Gray, Br. Radiata*, 118: *Busk, B.M. Cat.* ii. 77, pl. lxxxii. fig. 4, pl. xci. figs. 5, 6, pl. xcvi.; *Crag Pol.* 48, pl. v. figs. 6, 7, 8, pl. vi. fig. 4; (var. *labiosa*) *Quart. Journ. Micr. Sc.* iv. 309, pl. x. figs. 5, 6: *Heller, Bryoz. d. Adriat. Meer.* 32.

LEPRALIA IMMERSA, *Johnst. B. Z.* ed. 2, 325, pl. lvii. fig. 8.

BERENICEA IMMERSA, *Flem. Br. An.* 533: *Couch, Corn. Faun.* pt. iii. 118.

ESCHARELLA IMMERSA, *Gray, Br. Rad.* 125.

DISCOPORA COCCINEA, forma PEACHII, *Smitt, loc. cit.* 26 & 170, pl. xxvii. figs. 164-166, & 167 (referred to *L. ventricosa*).

? DISCOPORA EMUCRONATA, *id. Krit. Förteckn. Öfv. &c.*, 1871, 1129, pl. xxi. figs. 27, 28.

Zoæcia rhomboid, not separated by deep sutures, generally arranged quincuncially, granular or smooth, punctured or areolated round the margin; orifice suborbicular, longer than broad, well arched above, with a slightly raised and thickened peristome, which is produced in front into a pointed mucro, a small bifid denticle within the lower margin, and six slender oral spines. *Oæcia* small, globose, erect, with two spines in front, on each side.

Colonies forming large irregular patches of solid texture, which generally present a very flat and uniform surface.

Primary cell with somewhat circular aperture, occupying the upper portion of the front surface, surrounded by about nine spines; covering membranous (woodcut, fig. 16).

Fig. 16.



Primary cell.

Var. *a* (*labiosa*, Busk). *Zoæcia* ovate, distinct, more deeply divided than in the ordinary form, disposed in lines, smooth; orifice much raised, the front lip everted and much thickened and produced. (Plate LI. fig. 1.)

Var. *β* (*octodentata*). *Zoæcia* ovate, distinct, convex, smooth, disposed very regularly in linear series; orifice rather small, with a pointed mucro in front and eight marginal spines. *Oæcia* globose, prominent, set very far back, *all* the spines in front of it. (Plate LI. fig. 2.)

RANGE OF VARIATION. This species presents many diversities of appearance, due to age and locality; but there seems to be a very moderate amount of variation in the more important characters. In young specimens the cells are smooth and shining, and bristle with their long and slender spines. With age, and in deep-water localities, the silvery sheen is lost; the cells are thickened, and usually of a dull whitish colour, the surface of the zoarium is flat, the shallow sutures between the cells being almost

obliterated, the areolation is indistinct, the spines are wanting. In such specimens the conspicuous feature is the slightly everted and projecting lower lip of the aperture, which shows as a strip of brighter white on the dull uniform surface. The mucro is usually, in such cases, very inconspicuous; but the small bifid denticle is present, and the stumps of the six spines may be traced on the upper margin of the mouth. In this condition *M. Peachii* is of very frequent occurrence on stones and old shells from deep water. Very grotesque varieties are produced by the growth of the thick granular crust over the primitive cell-wall. Two striking examples are represented in Plate L. figs. 4, 5.

The var. β (*octodentata*) is distinguished by its convex, smooth cells and by the position of the ovicell *behind* the numerous spines. There are commonly eight, occasionally only six; but, in either case, the whole number show in front of the oœcium. This form bears some resemblance to the *Discopora emucronata*, described by Smitt from Spitzbergen; but in the Shetland specimens the mucro is certainly not absent. In other respects the two forms agree, and especially in the position of the ovicell *behind* the numerous spines. This peculiarity, however, can hardly be accounted of any great importance; in *M. ventricosa* the oœcium is often set very far back, so that the whole four spines are visible in front of it, although commonly only one is to be seen on each side.

HABITAT. On *Laminaria*, stones, shells, &c., from tide-marks to deep water (170 fathoms).

LOCALITIES. Universally distributed on our coasts. Var. *labiosa*. Belfast Bay, deep water (W. T.): Guernsey (T. H.). Var. *octodentata*. Shetland (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): France, S.W., not common (Fischer): Greenland (German Pol.

Exped.) : Bahusia, common, on marine plants in the littoral region chiefly (Smitt) : Bergen (A. M. N.) : Marsouin, Gulf of St. Lawrence (Dawson) : Adriatic, rare (Heller).

RANGE IN TIME. Coralline Crag, very abundant (S. Wood) : Middle Pliocene beds (Suffolk Crag) ; Upper Pliocene ; Palæolithic (A. Bell) : Scotch Glacial deposits (Geikie).

MUCRONELLA VENTRICOSA, Hassall.

Plate L. figs. 6-8.

LEPRALIA VENTRICOSA, *Hass.* Ann. N. H. ix. 412 : *Johnst. B. Z.* ed. 2, 305, pl. liv. fig. 5 : *Busk*, B.M. Cat. ii. 78, pl. lxxxii. figs. 5, 6, ? pl. lxxxiii. fig. 5 (*not* pl. xci. figs. 5, 6) ; Crag. Pol. 49, pl. vi. figs. 3 & 6 : *Manzoni*, Bryoz. Mediterr. Suppl. Contr. i. 7, pl. iii. fig. 1.

DISCOPORA COCCINEA, forma VENTRICOSA (part.), *Smitt*, l. c. 26 & 172, pl. xxvii. fig. 172 (?).

LEPRALIA ARRECTA, *Reuss*, Foss. Bryoz. österreich.-ungarisch. Miocän, 24, pl. ii. fig. 11.

Zoæcia rhomboid or ovate, or subglobose, distinct, convex, divided by deep sutures, contracted and more or less suberect above, usually disposed very regularly in linear series ; surface granular, and often traversed by radiating furrows, a single row of punctures round the base ; orifice suborbicular, a large bifid denticle within the lower margin ; peristome raised and thickened, rising in front into a broad, prominent mucro, which is sometimes bifid ; marginal spines four, stout, two on each side. *Oæcia* globose, closely united to the cell above, smooth or subgranular, with one or sometimes two spines in front of it, on each side.

Colonies of a greyish-white colour, often silvery and glistening, forming large crusts, which frequently assume a lobate figure.

RANGE OF VARIATION. Like its congener *M. Peachii*, this species varies much in appearance under different conditions of age and habitat; but the characters are very constant. When old, the cells are of a dead white colour; but in younger states they are bright and glossy. The texture is delicate and somewhat vitreous at first, but becomes coarser and more granulous with age. Except in the earliest states, the cells are almost always more or less granular. The shape is generally ovate, sometimes rhomboid. The oral extremity is more or less elevated, and the aboral immersed; but this is often by no means a marked character. The number of the spines is very constant; but occasionally a fifth is interposed between the pairs which occupy the two sides of the aperture. The mucro, which is always a striking feature, is at times exceedingly broad and massive, and occasionally bifid. The oœcium is sometimes subimmersed; more commonly it is very prominent; but it is always closely united to the cell above it. Not unfrequently all the spines project in front of the ovi-cell; but usually only one on each side is visible.

HABITAT. On stones, shells, &c., from shallow to deep water.

LOCALITIES. Less common perhaps than *M. Peachii*, but widely distributed. Shetland, 15–170 fathoms; Hebrides (A. M. N.): Beaufort Dyke, 110–147 fathoms (Capt. Beechey): Sana Island (Hyndman): Northumberland and Durham, deep water, rare (Alder): St. Andrews, deep water, not uncommon (Dr. McIntosh): Belfast Bay (W. T.): Dublin Bay; Burnham, Norfolk (Hassall): Start Point (Bowerbank): Cornwall, deep water; Guernsey (T. H.): &c.

GEOGRAPHICAL DISTRIBUTION. France, S.W., 30–50 fathoms (Fischer): Mediterranean (Manzoni): New Zealand (F. W. Hutton): Greenland, “the most abundant

Lepralian ;" found in all the inshore dredgings (Norman, 'Valorous' dredgings): Nova Zembla, Jugor-scharr, 10–14 fathoms; Matotschkin-scharr, 30–50 fathoms; Kara sea (Stuxberg & Théel): Bergen (A. M. N.): on the Falmouth-Lisbon cable, between N. lat. $47^{\circ} 58'$ and $47^{\circ} 35'$, and in W. long. $7^{\circ} 6'$, from 89–205 fathoms (Sir J. Anderson).

RANGE IN TIME. Coralline Crag (Searles Wood): Austro-Hungarian Miocene (*arrecta*) (Reuss): Middle Pliocene; Palæolithic (A. Bell).

The differences between this species and the preceding are very marked and constant; nor have I found that they show any tendency to run one into the other. In the first place the cells of *M. ventricosa* are always very much larger than those of *M. Peachii*, and the two, which often occur side by side on the same shell, may be distinguished at once by the size alone. They are also much more convex, presenting a well rounded anterior surface, and are consequently divided by deep sutures. The flat surface, so characteristic of *M. Peachii*, is never met with in this form.

The mouth is erect or suberect, and the cell narrows towards it—a peculiarity which is wanting in the last-named. Almost the whole of the inferior margin rises, as it were, into the mucro, which is broad and massive, whereas that of *M. Peachii* is a central acuminate process, and a much less prominent feature. The spines are not only fewer in number, but different in character from those of the allied species. They are, in the adult, very stout and tusk-like, ranged two on each side, and bend inwards over the aperture. The surface is more or less granular, and with a constant tendency to striation, which is not met with at all in the other species. The *oecium* is usually very small in proportion to the size of the cell.

In *M. ventricosa* the cells are arranged in linear series,

radiating in all directions from a central point, so that there is a definiteness and regularity of pattern which is usually wanting in *M. Peachii*.

MUCRONELLA VARIOLOSA, Johnston.

Plate LI. figs. 3-7.

LEPRALIA VARIOLOSA, *Johnst.* B. Z. 278, pl. xxxiv. fig. 4; *ibid.* ed. 2, 317, pl. iv. fig. 9 (? fig. 8): *Couch*, Corn. Faun. iii. 116: *Busk*, B.M. Cat. ii. 75, pl. lxxv.; *Crag*. Pol. 48, pl. iv. fig. 4 (? fig. 8), & pl. viii. fig. 8.

LEPRALIA OVALIS, *Hass.* Ann. N. H. ix. 413.

ESCHARELLA VARIOLOSA, *Gray*, B.M. Rad. 125.

? LEPRALIA CHEILOSTOMA, *Boeck*, Förh. Vid. Selsk. Christiana, 1861, 50.

LEPRALIA SERRULATA, *Reuss*, Bryoz. oesterreich.-ungarisch. Miocäns, 27, pl. ii. figs. 2, 3.

LEPRALIA TENERA, *id.*, *ibid.* 27, pl. ii. fig. 4.

Zoæcia lozenge-shaped or ovate-elongate, often much produced and narrowed below, flattish, distinct, but not deeply sutured, sometimes subimmersed, granular, quincuncially arranged, punctured or strongly areolated round the base, and bordered by a raised line; orifice suborbicular, slightly elongated transversely, a hammer-shaped denticle within the lower lip; peristome raised, thin, everted in front, and usually extended into a central mucro; marginal spines 2-4. *Oæcia* somewhat oval, depressed and immersed, closely united to the adjacent cell, granular, areolated round the margin, usually with one spine in front on each side.

Primary cell minute, with an oval aperture occupying the whole of the front surface, bordered by a slight rim, and surrounded by ten or eleven spines.

Colonies forming very large, bright, glistening crusts, white or straw-coloured.

RANGE OF VARIATION. The cells are, in some cases, broader and shorter than in others; but usually they are much

elongated, lozenge-shaped, or nearly oval, and much narrowed below. The mucro is sometimes bidentate, and occasionally almost abortive. The greatest amount of variation occurs in the marginal areolation, which in some cases almost disappears, whilst in others it exists in such an exaggerated condition as completely to change the appearance of the species. Specimens in which this occurs are often of very great beauty, the areolation occupying a large portion of the surface of the cell, and a small central space only being left smooth. In other cases the areolation is very partial, in others extremely obscure; in others it is represented by mere superficial ribs. A variety occurs in which the cells are very flat, the peristome is not elevated, and the anterior margin scarcely prominent. In another and very pretty form the cells are not much produced, are bordered by a white sinuous line, and speckled with very distinct, minute white granules on a grey ground. With age a thin white crust often forms over the primitive cell-wall, which is of a delicate greyish colour. Very old specimens present a flat surface, and the walls are thickened and strongly granulated.

HABITAT. On stones and shells from deep water.

LOCALITIES. Common, and generally distributed. It has not occurred in Shetland, nor on the Scandinavian coast. The Minch, Hebrides (Norman): St. Andrews, deep water (Dr. M'Intosh): Sana Island, 40 fathoms (Hyndman): Birterbuy Bay (G. S. B.): off the Deadman, 60 fathoms, on *Pinnæ* (T. H.): &c.

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): New Zealand (F. W. Hutton): Adriatic, rare (Heller): mouth of the Jenesei (subfossil) (F. Schmidt).

RANGE IN TIME. Coralline Crag, on shell (S. Wood): Middle Pliocene (Coralline Crag and Red Crag, part) (A. Bell): Austro-Hungar. Miocene (Reuss).

MUCRONELLA LAQUEATA, Norman.

Plate LI. fig. 8.

LEPRALIA LAQUEATA, *Norman*, Ann. N. H. January 1864, 85, pl. x. fig. 5.DISCOPORA COCCINEA, forma OVALIS (part.), *Smitt*, l. c., pl. xxvii. fig. 175.

Zoæcia rhomboid, broad, not produced below, very slightly convex, granular, bordered by raised lines, and with a row of large punctures round the base; orifice semicircular; peristome not raised, lower lip almost straight, pouting, a broad denticle deeply set within it; marginal spines three. *Oæcia* round, subimmersed, granular, punctured round the margin.

Colonies tinged with red when living, ivory white when dead; the surface dull.

HABITAT. On stones from deep water.

LOCALITY. Shetland, 80–100 fathoms; the Minch, Hebrides (A. M. N.): coast of Antrim (Hyndman).

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.): Arctic Seas (*Smitt*).

This species is a critical one, and perhaps approaches *M. variolosa* too nearly. It most markedly differs from it in having the cells much less elongated and much broader in proportion to the length, in being always reddish when living, and ivory-white when dead, and destitute of the shining surface which characterizes the last-named species. There is some difference, too, in the form of the mouth, which is wider and less arched (with less space between the upper and lower margins) than in *M. variolosa*. The lower margin is turned slightly outwards; though sometimes mucronate, the mucro is a much less constant and striking feature than in the allied species. The denticle, which is of great breadth, is very deeply planted within the

cell, whereas that of *M. variolosa* is prominent and conspicuous. The ovicells also seem to be less immersed. The walls of the cells are thick, and the surface is strongly granulated.

In general appearance the two forms certainly differ considerably; but, as Norman has remarked, "it is difficult to point out the distinction in words."

MUCRONELLA ABYSSICOLA, Norman.

Plate XXXVIII. figs. 1, 2.

LEPRALIA ABYSSICOLA, Norman, Shetland Pol., Rep. Brit. Assoc. 1868, 307.

Zoæcia large, distinct, broad in the middle, and tapering off towards each extremity, moderately convex, divided by well-marked sutures; surface minutely granular; orifice small, terminal, transversely elongated; the lower margin much raised, slightly bent outwards, forming a screen before the aperture, a wide denticle set deeply within it; upper margin not elevated, bearing two or three rather stout spines. *Oæcia* globose, tumid, broader than long, minutely granular, occasionally a small transverse rib just above the mouth; two spines visible in front.

Colonies forming large, white, glossy crusts, of irregular growth, on which the cells show very distinctly.

HABITAT. On stones, &c., from very deep water.

LOCALITY. Shetland, to the N.N.W. of Unst, in 140–170 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Gulf of St. Lawrence (Dawson).

The cells in this species are almost lozenge-shaped. In the centre they bulge out and attain a considerable breadth, but taper off above and below it, terminating in a point at

the base, and becoming much contracted towards the mouth, which is placed at the summit. The primary aperture is a simple opening, narrow between the upper and lower margins, but elongated transversely. In an early stage of growth the denticle is very apparent; but by the subsequent development of the lower lip, which rises into a broad and prominent expansion, the mouth is partially concealed, and it is then difficult to detect. The texture of the cells is dense; and so minute is the granulation of the surface that they appear almost smooth. They have a polished and glossy appearance. The full number of the marginal spines appears to be three; but there are often only two.

“The form of the ovicells and mouth in the fertile cells reminds one forcibly of a helmet with the vizor raised” (*Norman*).

In a fine specimen of the present species from the St. Lawrence, which I owe to Dr. Dawson, the cells are much more convex and distinct and deeply divided than in the Shetland form, and more elevated towards the oral extremity. The ovicell is also more decidedly thrown back off the mouth.

MUCRONELLA MICROSTOMA, *Norman*.

Plate XXXVIII. figs. 3, 4.

LEPRALIA MICROSTOMA, *Norman*, Ann. N. H. ser. 3, xiii. 87, pl. xi. fig. 2; Rep. Brit. Assoc. for 1868, 307.

Zoecia flask-shaped, very distinct, tumid, the oral extremity elevated, free, contracted into a short neck; surface smooth or finely granular; orifice small, contracted, much broader than long; peristome thickened, narrowed, much raised and everted in front, and on the upper margin rising to a central point. *Oœcia* globose, tumid, set far back, minutely granular.

Colonies often exhibiting an irregular outline, and giving off branching processes, three or four cells wide.

HABITAT. On small stones from deep water.

LOCALITY. Shetland sea, 20–25 miles N. and N. by W. of Unst, in 80–140 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. On the Falmouth-Lisbon cable, between N. lat. $47^{\circ} 58'$ and $47^{\circ} 35'$ and in W. long. $7^{\circ} 6'$, from 89–205 fathoms (Sir James Anderson).

In this species the cells rise considerably towards the upper extremity, and are produced into a short neck, which is quite free, and bears the mouth on the top of it. The lower part or body of the cell is ovate. The mouth is small, and as it were drawn out sideways, so as to be transversely elongate. It is surrounded by a simple, thickened peristome, which forms a “pouting lip” in front, and above is more or less pointed. The cells are without definite arrangement, are divided by well-marked sutures, and, according to Mr. Norman, “rise from a punctured crust, which fills up any interstices between them.” In the specimens which I have examined there is very little trace of such a crust; in most cases the cells are contiguous. The ovicell is recumbent and set well back behind the neck, and, like the cells, is almost smooth or very minutely granulated.

This is one of the species which it is very difficult to classify with any thing like certainty. It holds its place in the present genus chiefly from its apparent affinity to *M. abyssicola*.

b. *With two lateral avicularia.*

MUCRONELLA COCCINEA.

Plate XXXIV. figs. 1–6.

CELLEPORA COCCINEA, *Abildgaard*, Müll. Zool. Dan. iv. 30, pl. cxlvi. figs. 1, 2 :
Lamk. An. s. Vert. ed. 2, ii. 259.

BERENICEA COCCINEA, *Flem.* B. An. 533.

LEPRALIA COCCINEA, *Johnst.* B. Z. ed. 2, 322, pl. lvii. figs. 2, 3: *Busk*, B.M. Cat. ii. 70, pl. lxxxviii.

LEPRALIA TRIDENTATA, *Couch*, Corn. Faun. pt. iii. 115, pl. xxii. fig. 5.

LEPRALIA APPENSA, *Hassall*, Ann. N. H. vii. 367, pl. ix. fig. 3.

DISCOPORA APPENSA*, *Smitt*, loc. cit., Krit. Förteckn. iv. 27 & 175, pl. xxvii. fig. 177.

LEPRALIA BALLII, *Johnst.* B. Z. ed. 2, 321, pl. lvi. fig. 5.

ESCHARINA COCCINEA and BALLII, *Gray*, B.M. Rad. 124.

LEPRALIA MAMILLATA, *Searles Wood*, Ann. N. H. xiii. 19: *Busk*, Orag Pol. 46, pl. vi. fig. 5: *Manzoni*, loc. cit., Sec. Contr. 6, pl. ii. fig. 8.

LEPRALIA PTEROPORA, *Reuss*, Polyp. d. Wien. Tertiärbeck. 81, pl. ix. fig. 26
Manzoni, Bryoz. foss. Ital., Terza Contr. 4, pl. i. fig. 3†.

DISTANSESCHARELLINA PTEROPORA, *D'Orb.* Pal. Fr. ter. crét. v. 451.

LEPRALIA PEREGRINA, *Manzoni*, loc. cit. 6, pl. i. fig. 5.

? LEPRALIA FULGURANS, *id.* loc. cit. 7, pl. i. fig. 6.

? LEPRALIA QUADRICORNUTA, *Dawson*, Canad. Naturalist, 1857.

* *Smitt* does not identify the present species with the *Cellepora coccinea* of *Abildgaard*. He applies this name to *M. Peachii* and kindred forms. Little is to be made of the figures in the 'Zoologia Danica'; and the description is sufficiently vague; but the red colour is characteristic of the present species, and its cells may be properly described as "urceolate;" whereas in neither of these points will the description fit *M. Peachii*. In a case where absolute certainty is unattainable, it seems hardly worth while to disturb the widely accepted nomenclature.

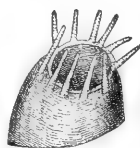
† I perfectly agree with *Manzoni* that *L. pteropora*, *Reuss*, and *L. mamillata*, *S. Wood*, must be referred to the present species. There can be little doubt that *L. peregrina* of this author (Bryoz. foss. Ital., 3rd Contrib. pl. i. fig. 5) must rank with them. These forms exhibit mere differences of superficial sculpture. *L. fulgurans*, *Manzoni* (*op. cit.* pl. i. fig. 6), also seems to be nothing more than a variety of *M. coccinea*, although, in the absence of specimens, I would not be understood to speak with certainty.

I feel more doubtful about the *Lepralia quadricornuta*, *Dawson*, from the Postpliocene deposits of Canada. I am indebted to Dr. Dawson's great kindness for specimens of this form, as well as of many other Canadian Polyzoa, both recent and fossil; and, after careful examination, I am inclined to think that it must be regarded as a variety of the present species. So far as the condition of the fossil allows me to judge, it agrees with the latter in all its characters, with perhaps a single exception. The form and sculpture of the cell and ovicell, the shape and position of the avicularia are the same in both. The surface of the cell is adorned with radiating furrows, and it is punctured round the base. The ovicell is small, round, recumbent; and in front of it two spines are distinctly visible, as in *M. coccinea*. The difference between the two seems to lie in the degree in which the peristome is developed. The condition of my specimen does not allow me to determine this portion of the structure with as much precision as I could desire; but

Zoæcia shortly ovate, often enlarged and rounded below, distinct, divided by rather deep sutures, depressed below, rising towards the aperture, bordered by a raised line, and punctured round the margin; surface roughened or granular; orifice terminal, subcircular, with a central tooth on the lower lip and two lateral denticles; the peristome elevated in front into a prominent mucro, by which the central tooth is partially concealed; marginal spines six; on each side of the orifice an *avicularium*, with a pointed mandible, which is directed outwards and slightly upwards. *Oæcia* globular, recumbent, surface granular, two spines visible on each side, in front of it.

Primary cell rather smaller than the rest, raised, surface smooth; aperture terminal, large, orbicular, with a membranous covering, and about twelve tall marginal spines (wood-cut, fig. 17).

Fig. 17.



Primary cell.

Colonies forming subcircular, glistening crusts, of an orange-red colour.

Var. *a* (*mamillata*). *Zoæcia* suberect, contracted above, ventricose below; the surface traversed by numerous furrows, which radiate from below the mouth to the sides of the cell, usually a line of perforations round the base; orifice suborbicular; the peristome much produced in front and at the sides; two lateral *avicularia*, erect, the mandible pointing straight upwards. *Oæcia* globose, sulcate, the *avicularia* standing erect on each side in front.

RANGE OF VARIATION. Apart from the mere superficial layer, the changes to which this species is liable are

it seems to me that the peristome is more elevated and projects more prominently in front than is usual in *M. coccinea*. I can detect no traces of the three denticles; but their absence may be due to the condition of the fossil. Considering the amount of variation to which the peristome is liable, we should hardly be justified in treating the difference to which I have just referred as a diagnostic.

neither numerous nor important. The shape of the cell varies to some extent, especially in crowded colonies ; but it commonly exhibits the normal figure, which is slightly contracted towards the aperture, and enlarged and rounded off below. In the ordinary form the peristome rises in front into a pointed central process, behind which the median tooth is often completely concealed. This process, which is a secondary growth, is more or less strongly developed. In the very beautiful variety described by Searles Wood from Crag specimens as *Lepralia mamillata*, and which I have recently detected amongst Mr. Hyndman's dredgings on the Antrim coast, the peristome is much produced in front and at the sides, and forms a thickened and somewhat expanded border round these portions of the mouth.

The avicularia, which constitute so striking a feature of the present species, vary considerably in size and, to some extent, in position. Normally there are two of them ; but one is frequently wanting ; and when both are present they are very often unequally developed. In the var. *mamillata*, instead of being turned outwards towards the side, they point straight upwards, and when the ovicell is present they stand erect, one on each side, in front of it.

The superficial changes to which *M. coccinea* is liable are very remarkable. In its earliest condition the cell-wall is of a greyish colour and very delicate texture, and perfectly smooth. It is soon, however, invested by an opaque crust, roughened on the surface, which after a time takes on a distinctly granular character. In old and deep-water specimens this granulous condition becomes much more pronounced ; and in one very beautiful variety the entire surface of both cell and ovicell is tessellated with smooth white bosses or granules of various sizes and shapes (Plate XXXIV. fig. 3). In var. *mamillata* there

is a complete change in the character of the sculpture, and instead of mere granulation we have radiating and slightly undulating furrows, which traverse with much regularity the surface of the cell, and give it a singularly elegant appearance. The ovicell is similarly adorned. This kind of sculpture is not absolutely confined to this variety; it occurs in the *Lepralia pteropora*, Reuss, which is undistinguishable in other respects from the ordinary forms of *M. coccinea**.

MONSTROSITIES. The following monstrosities have occurred to me:—

i. A cell, otherwise normal and fully equipped, with an avicularium covering the oral aperture.

ii. An avicularium with a quadrangular instead of a pointed mandible, of equal width throughout, and squared at the extremity.

HABITAT. On weed (chiefly *Laminaria*), rock, &c., between tide-marks and in shallow water, and on shells, Ascidians, &c., from moderately deep water (30 fathoms).

LOCALITIES. A very common littoral species. South Devon; Ilfracombe; Guernsey; Isle of Man (T. H.): Cornwall (Couch and Peach): Tenby (F. Walker): Hastings (Miss Jelly): Isle of Wight (W. T.): Northumberland and Durham (Alder): Ayrshire (Landsborough): St. Andrews, rare as compared with southern coasts (Dr. McIntosh): the Minch; Shetland, between tide-marks and in shallow water (A. M. N.): Belfast Bay (W. T.). Var. *mamillata*, coast of Antrim (Hyndman).

GEOGRAPHICAL DISTRIBUTION. Roscoff, very common (Joliet): France, S.W. (Fischer): Adriatic, on shells and Algæ (Heller): Norway (Sars): Spitzbergen, on Ascidians, 16–30 fathoms (Torell and Malmgren): Greenland

* *Vide* Manzoni, Bryoz. foss. Ital., Terza Contrib., pl. i. fig. 3.

(Lütken) : Nova Zembla, 10–50 fathoms ; Kara sea (Stuxberg and Théel).

RANGE IN TIME. Pliocene deposits, near Reggio, in Calabria ; older Pliocene, Castrocaro ; Middle Miocene (Manzoni) : Austro-Hungarian Miocene (Reuss). Var. *mamillata*. Crag (S. Wood) : Quaternary deposit at Livorno (Manzoni).

MUCRONELLA PAVONELLA, Alder.

Plate XXXIX. figs. 8–10.

ESCHARA PAVONELLA, Alder, Quart. Journ. Micr. Sc. n. s. iv. 12.

ESCHARA CRIBRARIA, Busk, Quart. Journ. Micr. Sc. iv. 311, pl. xii. figs. 1–3.

DISCOPORA PAVONELLA, Smitt, Cefv. K. Vet.-Ak. Förh. 1867, Bihang, 28 and 178, pl. xxvii. fig. 181.

Zoarium foliaceous, forming fan-shaped or undulating expansions, which rise from an incrusting or clasping base, or simply adnate, forming large circular patches. *Zoecia* large, rather broadly ovate, quincuncial, moderately convex, somewhat elevated towards the upper extremity, and depressed below, strongly areolated round the margin, and with ribs radiating towards the centre ; surface slightly roughened ; orifice very ample, orbicular, with a small blunt tooth on the lower margin ; peristome thin and not raised ; on each side of the orifice, about the middle, an oval *avicularium* ; mandible rounded and pointing upwards. *Oæcia* (?) .

Height of the erect form about $1\frac{1}{2}$ inch ; breadth generally exceeding the height.

HABITAT. On stems of zoophytes, Ascidians, tubes of annelids, shells, &c., from moderate depths to deep water.

LOCALITIES. Cullercoats (Alder) : coast of Northumberland, deep water (A. Hancock) : Scarborough (Bean) : Dogger bank, on mussel (T. H.).

GEOGRAPHICAL DISTRIBUTION. Gulf of St. Lawrence (Dawson): Greenland, off Frederickshaab, 100 fathoms (Wallich): Nova Zembla, Jugor-scharr, 10-14 fathoms (Stuxberg and Théel): Spitzbergen, 20-60 fathoms (Torell and Swed. Exped.): Finmark, 20 fathoms (Goës and Malmgren): west off Jutland, 26 fathoms (Kirchenpauer). Not yet found in Southern Scandinavia (Smitt).

This is a remarkably beautiful species. In its incrusting state it forms large patches (an inch in diameter) perfectly circular in shape, slightly depressed in the centre, and wearing the appearance, even to the naked eye, of most delicate lacework. When growing erect it assumes, according to Mr. Alder, the form *Hemeschara* or *Eschara* (of authors), according to the substance on which it is developed.

The zoecia are large and regularly arranged in quin-cunx; the surface is ornamented with ribs, which pass off from the margin and radiate towards the centre of the cell, inclosing rather large loop-like areolar spaces. In the older portions of the colony these are sometimes almost obliterated; but they are generally a conspicuous and characteristic feature. Smitt states that the mandible of the avicularia, though occasionally round, is usually triangular. This is certainly not the case in any of the specimens which I have examined, whether from this country or from Greenland and North America. In all cases I have found the rounded mandible only.

The mucronate elevation of the peristome, which is the usual characteristic of the present genus, is wanting in *M. pavonella*; but its affinities, on the whole, are with this group.

Genus PALMICELLARIA, Alder.

Der. From *palma*, the palm of the hand, and *cella*, a cell.

PALMICELLARIA, Alder, Quart. Journ. Micr. Sc. 1864.

CELLEPORA (part.), Flem.: Johnston: &c.

ESCHARA (part.), Busk: Sars: &c.

DISCOPORA (part.), Smitt.

GENERIC CHARACTER.—*ZOÆCIA* with the primary orifice orbicular, or ranging from semicircular to semielliptical; the peristome elevated around it, so as to form a secondary orifice, and carried out in front into a projecting palmate or mucronate process, with an avicularium on its inner aspect. *ZOARIUM* (in the British species) erect and ramose, or (?) lamellate.

DISTINGUISHED from the preceding genus by the secondary orifice, with its mucronate and aviculiferous process in front.

PALMICELLARIA ELEGANS, Alder.

Plate XXXI. figs. 7-9.

PALMICELLARIA ELEGANS, Alder, Quart. Journ. Micr. Soc. n. s. iv. (1864), 100, pl. iii. figs. 1-4: Norman, Shetland Pol., Rep. B. A. 1868, 309.

PUSTULIPORA PROBOSCIDEA, Johnst. B. Z. ed. 2, 278, pl. xlviii. figs. 4, 4 (*vide* Norman *).

Zoarium erect, very slender, of ivory whiteness, slightly branched dichotomously, branches nearly in the same plane, somewhat attenuated towards the top. *Zoæcia* disposed in four longitudinal rows, alternating with each other, oblong-ovate, smooth, very slightly defined;

* Who has examined the specimens bearing this name in Dr. Johnston's collection.

aperture round, somewhat depressed, with a prominent curved rostrum in front, bearing on its upper surface a circular *avicularium*. *Oæcia* unknown.

Height $\frac{6}{10}$ inch.

HABITAT. Deep water.

LOCALITIES. Zetland Seas (E. Forbes): Loch Fyne; the Minch, 18 to 25 miles north of Burrafirth lighthouse, the most northern point in Shetland, 80–90 fathoms (A. M. N.).

This is a very elegant species; slender in habit, of a pure whiteness, and remarkable for the neatness and regularity of its dichotomous branching.

It differs from its congeners in having its cells disposed in *four* longitudinal series; but the mere number of the rows is not a point of any special importance.

PALMICELLARIA SKENEI, Ellis and Solander.

Plate LII. figs. 1–4.

MILLEPORA SKENEI, *Ell. & Sol. Zooph.* 135,

CELLEPORA PALMATA, *Flem. B. A.* 532.

CELLEPORA SKENEI, *Johnst. B. Z.* ed. 2, 297, pl. lii. figs. 6, 7, 8: *Busk, B.M. Cat.* ii. 88, pl. cxvii.

ESCHARA SKENEI, var. TRIDENS, *Busk, Ann. N. H.* ser. 2, xviii. (1856), 33, pl. i. fig. 3: *Sars, Beskr. norske Polyz., Vid. Selsk. Christiania*, 1862, 147 (9 sep.).

LEPRALIA BICORNIS, *Busk, Crag Pol.* 47, pl. viii. figs. 6, 7.

DISCOPORA SKENEI, forma *Escharæ* auctt. (part.), *Smitt*, l. c. 29 and 179.

Zoarium rising from a spreading crustaceous base, dichotomously branched, of a reddish or yellow colour; branches somewhat palmate, compressed, or flattened, short, dilated and truncate above, rough and hispid. *Zoæcia* elongate, subcylindrical, distinct, and moderately convex, elevated towards the upper extremity, and finely granulated; orifice arched above, the inferior

margin slightly curved inwards; peristome elevated in the adult cell, forming a secondary aperture, with a circular *avicularium* on its lower lip; immediately in front of it a tall mucro. *Oæcia* small, globose, very closely united to the surface of the cell above, granular. Height $\frac{1}{2}$ to 1 inch.

Var. *a* (*bicornis*). With a cylindrical process on each side of the orifice, bearing an *avicularium* on the summit.

Var. *β* (*foliacea*). *Zoarium* forming a broad foliaceous expansion, contracted towards the base, and rising from a spreading crust: entire, contorted, and sinuated on the margin.

HABITAT. On zoophytes, stones, and shells, from deep water.

LOCALITIES. Aberdeen (Skene): Wick (C. W. P.): St. Andrews (var. *foliacea*), on *Cyprina Islandica*, from the Coralline ground (Dr. M'Intosh): 8 miles S.S.W. of Mull of Galloway, 50 fathoms; 5 miles S.W. of Mull of Galloway, 110–140 fathoms (Capt. Beechey): the Minch; Shetland, 5–10 miles east of Balta, 40–70 fathoms; Out Skerries Haaf (A. M. N.): Northumberland and Berwick, not rare (Johnston): Oban (var. *bicornis*); Torbay; off Polperro (T. H.): on stones and *Pinnæ*, off the Deadman, rare (Couch): east coast of Ireland, very deep water (Miss Ball): off the Maiden lighthouses, coast of Antrim, 62–72 fathoms (W. Swanston).

GEOGRAPHICAL DISTRIBUTION. France, S.W., 50–60 fathoms (Fischer): Roscoff (Joliet): west coast of Norway to Finmark; Öxfjord and Komagfjord, 20–30 fathoms, on stony ground (Sars): var. *tridens* (Busk), Norway (M'Andrew): Greenland (N. Germ. Pol. Exped.): Kara sea (Stuxberg and Théel): St. George's Banks, 28–60 fathoms (Smith and Harger).

RANGE IN TIME. Var. *bicornis*, Crag (S. W.).

In its ordinary condition *P. Skenei* is distinguished by broad, flat, somewhat palmate and rather short branches, which expand slightly above, and seldom lie in the same plane; the surface is made rough and hispid by the numerous tall mucronate processes which rise from the front of the cells*. It is liable, however, to many changes of habit; and in the remarkable variety β (*foliacea*) it has entirely lost its usual manner of growth. In this form it appears as a continuous lamina, curved and twisted and folded upon itself, with a deeply sinuated margin. So far as external aspect goes, the contrast between this foliated variety and the normal condition is complete and striking; but in the minute characters there is perfect agreement between them. In the young zoecium there is no elevation of the peristome, the orifice is on a level with the general surface of the cell, and there is no trace of avicularia; but with advancing growth the peristome rises, and is carried outwards, projecting considerably, and at its extremity in front the avicularium is developed, the mucro ascending immediately below it. A secondary orifice is thus formed, which incloses the primary, and which differs from it widely in size and shape.

The mucro is tall and acuminate, except on the cells towards the base of the zoarium, where it is sometimes blunt and rudimentary. Occasionally a mucro is developed on each side of the orifice, and bears an avicularium on its inner surface at the base, or at times on its summit. The latter variety is the *Lepralia bicornis*, Busk. Occasionally the two processes are developed in a line with the central mucro; and we have then the variety *tridens* of Busk.

In some cases the zoarium glistens as if coated with varnish.

* “. . . densis hastilibus horrida.”—VIRGIL.

PALMICELLARIA LOREA, Alder.

Plate LII. figs. 5, 6.

ESCHARA LOREA, *Alder*, Quart. Journ. Micr. Sc. n. s. iv. 104, pl. iii. figs. 5-7 :
Norman, Shetland Pol., Rep. Brit. Assoc. 1868, 309.

DISCOPORA SKENEI, forma *Escharæ* auctt. (part.), *Smitt*, Œfv. K. Vet.-Ak.
 Förh. 1867, Bihang, 29 and 179.

Zoarium yellowish white, shining, dichotomously branched; branches slender, compressed, of nearly equal width throughout, blunt and generally bifid at the extremities, disposed nearly in the same plane, occasionally anastomosing, given off from a slender compressed stem. *Zoæcia* prominent, distinct, ovate-elongate, finely granulated, quincuncially arranged; orifice arched above, slightly curved inwards below; wall of the cell raised and thickened round it; a circular *avicularium* within the lower lip, and immediately below it a short, blunt rostrum; small circular *avicularia* scattered irregularly over the cells. *Oæcia* small, globose, closely united to the cell above, and inconspicuous, slightly granulated; surface entire.

Height 1 inch to 1½ inch.

HABITAT. In deep water.

LOCALITIES. Shetland (*Barlee*): 20-25 miles north of *Burrafirth* lighthouse, 80-110 fathoms (A. M. N.).

The differences between this species and the preceding are found almost entirely in the habit and mode of growth. The two are united by *Smitt*; and it is not without hesitation that I have decided to keep them apart. In general appearance they are distinct enough, though perhaps not more distinct than *P. Skenei* and its variety *foliacea*.

The habit of *P. lorea* is more erect, and the mode of

growth more regular, than those of the last-named species. The slender, flattened stem usually divides dichotomously into two principal branches; and these again divide and subdivide, also dichotomously. All the branches are much in the same plane, and occasionally meet and inosculate. The plan of the ramification is regular; and there is a neatness of habit which is wanting in *P. Skenei*.

The branches and stems are very much of the same width throughout, and there is no tendency to dilatation at the extremities. The surface is comparatively smooth in the absence of the tall spines with which the cells bristle in *P. Skenei*, and glossy. Mr. Norman tells me (*in litt.*) that when "it comes up in the dredge the whole zoarium is glistening and bright with prismatic colours."

When we turn to the minute characters we are much more impressed by the agreement between the two forms than by the points of difference. The latter may be very briefly summed up. The cells of *P. lorea* are somewhat broader and less decidedly subcylindrical than those of *P. Skenei*; the peristome, though raised, is not carried outwards in front, so as to project prominently, as in the last; and the rostrum is blunt and short. The small avicularia distributed over the zoarium have not been noticed in *P. Skenei*. In other respects the zoœcia of the two forms agree; the history of the development is the same; the leading features are identical in both.

In *P. lorea* a rostrum is occasionally developed, as in the preceding species, on each side of the orifice, which sometimes bears an avicularium at its base.

There are frequently punctures round the margin of the cells; but they are apt to be obliterated by the progress of calcification.

Doubtful Species.

PALMICELLARIA (?) CRIBRARIA, Johnston.

ESCHARA CRIBRARIA, *Johnst. B. Z.* ed. 2, 352, pl. lx. figs. 7-9.

Zoarium rising from a circular crustaceous base, erect, frondose, expanding into broad undulated and sinuous lobes, consisting of a double layer of cells. *Zoæcia* oval or rhomboidal, quincuncial, punctured; orifice (apparently) suborbicular, with a short mucro projecting in front.

Height $\frac{3}{4}$ inch; breadth about the same.

LOCALITY. Berwick Bay, 45 fathoms (Johnston).

Alder was the first to separate this form from *Mucronella pavonella*, with which Busk had identified it; and little can be said of it but that it is indubitably distinct from the latter. Johnston's description and figures of it are quite inadequate; and until it occurs again and can be studied afresh it is impossible to determine with any certainty its affinities and systematic position.

In the older portions of the colony the surface is said to be "punctured like a thimble, with round depressed holes," and the space between them to be punctulated. The mature cells are furnished with a mucro, which projects over the mouth. The adult orifice, judging from the figure, seems to be suborbicular and somewhat elongated transversely. In young cells it is described as "minute, round, and generally inconspicuous."

This species is referred provisionally to the genus *Palmicellaria*.

Genus RHYNCHOPORA, *Hincks*.

Der. From ῥύγχος, a beak, and πόρος.

LEPRALIA (part.), auctt.

DISCOPORA (part.), Gray.

GENERIC CHARACTER.—ZOECEIA with the primary orifice transversely elliptical, lower margin slightly sinuated; secondary orifice suborbicular, with a mucro on the lower margin and an uncinatè process immediately above it, within the mouth. ZOARIUM (in the British species) incrusting.

THIS form is a difficulty in the way of the systematist. Its most strongly marked characters—the mucronate lip and the curious uncinatè process within the orifice—connect it with the present group; but the lower margin of the primary opening is undoubtedly furnished with a sinus—a point in which it agrees with the *Myrizoidea*. It must be regarded as one of those transition forms which are continually reminding us how little the real order of nature can be represented by a rigorous and unbending system. I had placed it here, the existence of the sinus having escaped my observation; but I now think that it should rank as a Myrizoidan form having strong affinities with the present family.

RHYNCHOPORA BISPINOSA, Johnston.

Plate XL. figs. 1–5.

LEPRALIA BISPINOSA, *Johnst.* B. Z. ed. 2, 326, pl. lvii. fig. 10 (very indifferent):
Busk, B.M. Cat. ii. 77, pl. lxxx. figs. 1–4: *Hincks*, Devon &
 Cornw. Cat., Ann. N. H. ser. 3, ix. 205 (45 sep.).

DISCOPORA BISPINOSA, *Gray*, B.M. Rad. 126.

Zoæcia ovate, depressed below, rising towards the mouth,

granular, glossy, punctured round the edge; orifice (adult) suborbicular, somewhat elongated transversely, within the lower margin a curved hook-like process, and immediately below it a tall sharply pointed mucro; peristome elevated, rising on one side, or on both sides, into a strong spinous process, on the upper margin (in young cells) two long and slender spines; frequently below the orifice a mound-like swelling bearing at the upper end a large *avicularium*, placed transversely with a strong beak and a pointed mandible; on the lower part of the cell a raised, projecting *avicularium* with an acute mandible. *Oæcia* more or less immersed, semi-circular, smooth or granular, generally with a prominent mucro on the front, the opening closed by a smooth calcareous operculum, white or yellowish white.

Colonies forming large crusts, of a delicate lilac colour when fresh.

RANGE OF VARIATION. The specific diagnosis is founded on fully developed cells; but in different stages of growth the species presents a very different appearance, and, in a large proportion of cases, some of the structures which I have described are wanting. Colonies frequently occur in which the large transverse avicularia are either absent altogether or very sparingly developed; in well-developed patches I have frequently been unable to find one of them. When they are present they conceal the curved process on the lower margin, which is so characteristic of the species. In the absence of the mound and avicularium, the mucro rises from the lower lip of the secondary orifice. The spinous processes on the side of the mouth vary in number and are sometimes wanting; and the two true spines on the upper margin are rarely to be found, except on the edge of the colony. I know of few species, if any, which appear in such varied guise as the present.

In the interior of the colony the cells are crowded,

reduced in size, and flattish, the sutures disappear, and the punctures mark out the boundaries ; under such circumstances the ovicell is completely immersed. The marginal perforations are at times a very conspicuous character ; but in many cases they are hardly distinguishable. The young marginal cells are regularly ovate, perfectly smooth and horizontal, with a somewhat transversely elliptical aperture, very slightly sinuated below, and two slender spines on the upper lip. At a very early stage a small central prominence appears on the lower margin, which, increasing in size, bends over to one side, and forms the uncinatè process to which reference has been made. A small denticle projects from the side of the orifice towards which it inclines ; and the two processes, meeting, inclose a circular space. Immediately behind this process, the foundations of the avicularian swelling (or mound) are traceable on some of the cells and in some colonies, while in others the suboral mucro rises in the same position*. In the second or third line from the edge the cells have generally acquired their granular covering and their polished and glistening appearance. The small avicularia, which are much elevated, are variable in number ; and two or three are frequently met with on a cell.

In sheltered situations the suboral mucro is much developed, and the surface of the zoarium bristles with long spear-like processes.

HABITAT. On stones and shells from shallow to deep water.

LOCALITIES. Berwick Bay, on *Modiola* (Johnston) : South Devon, abundant ; Cornwall, off the Deadman, 60 fathoms ; Guernsey (T. H.) : Shetland, 50–170 fathoms (A. M. N.) : Caithness, very rare (C. W. P.).

* This seems to be the normal position of the mucro ; it is, as it were, displaced when the avicularium is present.

GEOGRAPHICAL DISTRIBUTION. Mazatlan ; Adelaide (T. H.).

The appearance of *R. bispinosa* is much altered by the absence of the large oral avicularia. When present they form a striking character, and add much to the picturesqueness of a very remarkable species. The swelling on which they are developed is clearly a modified cell; and in an early stage of growth its foundations are marked out in raised lines, just as the nascent zoœcia are outlined round the edge of the crust. The mode of its formation from the first to the final stage may be studied on the margin of any fresh and growing colony in which it is present.

Genus RETEPORA, *Imperato*.

Der. From *rete*, a net, and *πόρος*.

MILLEPORA (part.), Linnæus : Pallas : Ellis : &c.

RETEPORA, Imperato (*Retepora eschara marina*) : Johnston : Busk : D'Orbigny : Smitt : &c.

RETEPORA (part.), Lamarck : Blainville : &c.

ESCHARA (part.), Smitt.

DISCOPORA (part.), Smitt.

GENERIC CHARACTER.—ZOËCIA *disposed on the front surface of an erect and ramose zoarium, the branches of which usually inosculate and form a reticulate expansion; orifice semicircular or semielliptical, with a prominent rostrum on the lower margin, bearing an avicularium. ZOARIUM adherent by means of an incrusting base, composed in great part of aborted cells; avicularia developed on both the back and front of the zoarium.*

THE present genus, as originally constituted, was founded solely on the reticulated condition of the zoa-

rium ; but it now seems more than doubtful whether this character alone can supply the basis for a generic group. The reticulation is merely a peculiar form of ramification, and is probably entitled to no more systematic weight, apart from the characters of the zoæcium, than the simple branching, which was the distinction of the old genus *Eschara*. The retiform zoarium is associated with very different types of cell, whilst, on the other hand, a form in my possession (probably from the Red Sea), which cannot be distinguished generically, in other respects, from many of the *Reteporæ*, exhibits no trace whatever of reticulation, but has its zoarium as simply branched dichotomously as an *Eschara* or *Hemeschara* of authors. Strongly marked as is the facies which its peculiar habit of growth gives to the Retepore, we must not assign too much weight to it as a clue to natural affinity. There are some points, however, connected with the Reteporine group, which may possibly have a greater significance. In all cases, I believe, the zoarium originates in an expanded crust, composed in great part of aborted cells, destitute of an oral aperture, but frequently furnished with an avicularium, occupying its place. The centre of the incrusting base, however, is occupied by a subcircular group of fully developed zoæcia, round the edge of which gemmation takes place at intervals in an upward direction, and a number of erect lobes are thus formed, which constitute the rudiments of the (usually) reticulate and cup-shaped zoarium. (See page 391, woodcut, fig. 18.) This mode of growth is very peculiar, and, so far as I know, it is universal amongst the forms which have been hitherto included in the genus *Retepora*.

Our two British species exhibit the same type of zoæcium, and this allies them to the *Escharidæ*; I have therefore ranked them in this family under the old name,

leaving the general question as to the grouping of the Reteporine forms to be settled after a more extended study of their structure and morphology than is possible within the limits of our Fauna.

Smitt has dismembered the genus *Retepora*, and has placed our *R. Beaniana* in his genus *Eschara* as the companion of *Porella compressa*, *Porella lævis*, and other species. In this determination I am quite unable to agree with him, as, besides other differences, *R. Beaniana* seems to me to depart widely from the zoœcial type of the genus *Porella*.

It may be remarked that amongst a considerable proportion of the species which have been hitherto ranged under the genus *Retepora* there is a large amount of *general agreement*, apart from any consideration of the minuter details, or the mere peculiarity in the branching; they have many salient features in common, and leave on the mind of the student the impression of strong affinity as-existing amongst them. The mode of origin and the general character of the zoarium seem to be much the same in all of them; the existence of avicularia on the dorsal surface is a very usual character; these appendages are exceptionally numerous, and their prevalent forms are similar to a large extent; the fissured ovicell is commonly (though not universally) present. It is possible that in these and other characteristics we may have the indications of a natural group, under which the various modifications in the structure of the orifice &c. which actually occur may be properly ranged. But the materials for a judgment on this point are at present wanting.

RETEPORA BEANIANA, King.

Plate LIII. figs. 1-5.

MILLEPORA CELLULOSA, *Jameson*, Werner. Mem. i. 560.

RETEPORA CELLULOSA, *Johnston*, Loudon's Mag. N. H. vii. 638, fig. 69.

RETEPORA BEANIANA, *King*, Ann. N. H. xviii. (1846), 237: *Johnst.* B. Z. ed. 2, i. 353, fig. 67: *Busk*, B.M. Cat. pt. ii. 94, pl. cxiii. figs. 1-5; *Crag Pol.* 75, pl. xii. figs. 2, 5, 6, & 7.

? RETEPORA CELLULOSA (part.), *Sars*, Reise i Lof. og Finn. 31.

? LEPRALIA LOBATA, *Busk*, *Crag Pol.* 50, pl. vi. fig. 7, pl. xxii. fig. 4 (the young state).

RETEPORA CELLULOSA, forma BEANIANA, *a*, var. BOREALIS, *Smitt*, *Øfv. &c.* 1867, Bihang, 34 and 200, pl. xxviii. figs. 217-221.

ESCHARA BEANIANA, *Smitt*, *Bryoz. Nova Zembla*, *Øfv. &c.* 1878, no. 3, 23.

Zoarium infundibuliform or cup-shaped, wavy, undulated, the recurved edges sometimes uniting and forming more or less cylindrical cavities; or consisting of a broad, spreading expansion, much and irregularly contorted, the margin sinuated and recessed; with a very short rudimentary stem, which rises from a small, subgranular, incrusting base; *fenestræ* oval, rather large. *Zoæcia* cylindrical, slightly convex, elevated towards the upper extremity; surface smooth; orifice (primary) arched above, lower margin almost straight, and in the centre of it a short rostrum, supporting an *avicularium*, with semicircular mandible directed downwards*, two or three minute denticles projecting from the inner side of the avicularium; peristome thin, slightly elevated, and rising on each side of the mucro into a small point or denticle; oral spines in the young cells six, in the older four, tall and acuminate, of which two are situated a little above the lower margin and are visible in front of the ovicell. *Dorsal surface* subgranular, vibicate, traversed by raised white lines; at the

* *Smitt* describes a small, sessile, obliquely placed avicularium, with a triangular mandible, as occasionally developed at the base of the rostrum close to its side. This seems to be very rarely present.

top of each *fenestra* usually a small, raised, subcircular avicularium. *Oæcia* somewhat elongated, smooth, frequently subimmersed, with a slit-like fissure in front. Many small oval avicularia distributed over the zoarium on both surfaces.

Height, of fine specimens about $1\frac{1}{4}$ inch, more usual size $\frac{1}{2}$ – $\frac{3}{4}$ inch. Breadth of the spreading foliaceous form sometimes as much as 2 inches.

HABITAT. On shells, stones, corals, &c. from shallow to very deep water.

LOCALITIES. Northumberland, from the deep-water fishing-boats (King): off the coast of Durham, 60 fathoms (R. Howse): Embleton Bay, deep water, remarkably large and fine specimens from this locality (R. Embleton): Peterhead, two specimens (C. W. P.): Scarborough (Bean): Orkneys (E. Forbes and Barlee): Shetland and Fulah Island (Jameson): the Minch; Shetland, occasionally on the Unst Haaf, to 170 fathoms; abundant on the Out-Skerries Haaf, not so large as on the Northumberland coast (A. M. N.) *.

GEOGRAPHICAL DISTRIBUTION. Arctic Sea (Sir E. Belcher): Bohuslän and Norway, pretty common, from 20–30 to 200–300 fathoms, in the latter depths on *Gorgonia* and *Oculina* (Baron Ugglä and Prof. Smitt): Finmark, not rare (Smitt).

RANGE IN TIME. Coralline Crag (S. W.): Red Crag (A. Bell) †.

* This species is said to have been obtained by Allman at Cape Clear; but as no other southern locality for it is known, I venture to think that there may have been some mistake, and that one of the nearly related forms may have been confounded with it. The *Retepora Beaniana* of my 'Devon and Cornwall Catalogue' is the *R. Couchii* of the present work.

† The Italian Pliocene form which Manzoni refers to *R. Beaniana* (Bryoz. Foss. Ital., Quarta Contrib. p. 19, pl. v. fig. 26) is *R. Couchii*, *mili*.

This lovely form, whilst frequently assuming the shape of a cup, exhibits a very considerable variety of habit. The prettiest specimens which I have seen, though small in size, are developed on shells of *Ditrupa* from Shetland (Plate LV. fig. 2). They are regular in form, resembling a shallow cup, slightly undulated, and sometimes compressed transversely, and of a glossy ivory whiteness. The little Coralline clasps the slender gracefully curved shell with its spreading base, and rises to a height of about half an inch. In another very characteristic form, from Embleton Bay, there is an intricacy of structure which is altogether wanting in the one which I have just described. The breadth of the specimen is a little less than double the height; the habit is spreading, the growth irregular. Above the central cup-like depression, which formed the first stage in the growth of the zoarium, the reticulated lamina is enormously developed on one side (or face) only, attaining a height of about an inch, and a width of nearly two inches; on the opposite side (or face) it is quite rudimentary, so that the cup-like form is lost, and the zoarium has the appearance of a broad foliaceous expansion, variously twisted and curved, with a deeply sinuated margin. In some cases the sinuses are completely inclosed by the union of the opposite edges of the lamina, and a number of funnel-shaped or subcylindrical cavities are formed, which give a singularly involved and labyrinthine character to the whole. In yet another form there is still less trace of a cup, and the zoarium forms a broad, spreading, contorted expansion.

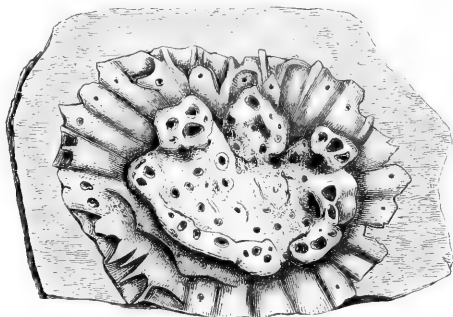
The minute characters are very constant. The rostrum on the lower margin of the aperture, which supports the avicularium, is never elongated as in *R. Couchii*, but is always rudimentary. The minute denticles projecting from the inner side of the avicularium are also a distinc-

tive character. There is no trace of the partially closed, loop-like marginal fissure which occurs in several of the members of the genus. The large avicularium with a hooked beak is altogether wanting; but the small oval avicularia are generally distributed in great numbers over the zoarium.

The semielliptical shape of the aperture is concealed by the rostrum and the growth of the peristome; but it is apparent in the marginal cells. The adherent base is a shining subgranular crust, divided by well-marked lines into somewhat ovate cell-areas; these are destitute of an oral aperture; but its place is usually occupied by a small circular avicularium.

The *Lepralia lobata* of Busk is founded on the rudimentary stage of a *Retepora* (possibly of the present species); and the mode of growth is well displayed in one of the figures which he has given in his 'Crag Polyzoa' (plate xxii. fig. 4 a). In the centre of a spreading crust a rather thick subcircular patch is formed; and round the edge of it rise a number of short erect lobes, which constitute the rudiments of the reticulated cup. As they increase in height they anastomose and form the first meshes of the network.

Fig. 18.



Young state of *Retepora*.

RETEPORA COUCHII, Hincks.

Plate LIII. figs. 6-11.

RETEPORA BEANIANA, *Hincks*, Devon Cat., Ann. N. H. ser. 3, ix. 308 (50 sep.).RETEPORA COUCHII, *id.* Ann. N. H. ser. 5, i. (1878), 355, pl. xviii. figs. 1-6: Waters, Bryoz. Bay of Naples, Ann. N. H. ser. 5, iii. 200, pl. v. figs. 3-6.RETEPORA CELLULOSA, var. BEANIANA, *Manzoni*, Bryoz. foss. Ital., Quart. Contr. 19, pl. v. fig. 26 (Sitzb. k. Akad. d. Wissensch. Bd. lxi. 1. Abth., März-Heft, 1870).

Zoarium irregularly cup-shaped, undulated and contorted, with a sinuated margin, hispid; *fenestræ* smaller than in the last species and less regularly oval. *Zoæcia* subcylindrical, depressed, except at the upper extremity, surface smooth; orifice semielliptical, the front margin produced into a tall rostrum, broad below and narrowing towards the apex, much bent outwards, and bearing on its summit a minute *avicularium*, with rounded mandible; peristome elevated on one side of the rostrum into a broad, wing-like process, produced at its upper and outer angle into a spine; a narrow, slit-like fissure between the rostrum and the process, closed above, but forming a loop-like foramen below; oral spines six; elongate, linguiform *avicularia*, with a very delicate mandible, distributed over the zoarium, frequently one on the front of the cell at one side, a little below the rostrum; dorsal surface smooth, dense, with many small subcircular *avicularia*, and occasionally one of the linguiform kind, irregularly placed. *Oæcia* elliptical, smooth, with a narrow longitudinal fissure.

Height (of the largest specimen) a little more than $\frac{1}{2}$ inch, breadth about $\frac{3}{4}$ inch.

HABITAT. On stone, &c., deep water.

LOCALITIES. Off the Land's End (R. Q. Couch): Southwest of Polperro, 40 fathoms, on stone (T. H.): Guernsey (A. M. N. & Dr. McIntosh).

GEOGRAPHICAL DISTRIBUTION. Mediterranean, 390 fathoms ('Porcupine' Exped.): Bay of Naples (Waters).

RANGE IN TIME. Italian Pliocene beds (Manzoni).

This species is very distinct from either *R. Beaniana* or *R. cellulosa*, Smitt. It seems to be a southern form: all my specimens are from Cornwall; and it is not included amongst Smitt's Scandinavian *Polyzoa*. The very much produced and recurved rostrum, with its minute, terminal avicularium, and the wing-like elevation of the peristome on one side of it, are the most salient features. These characters distinguish it from both the forms just mentioned; and it is further separated from them by differences in the avicularia and fenestræ.

The surface of the zoarium in *R. Couchii* is rendered hispid by the immense number of tall, projecting rostra. The avicularia which they support are very minute, as compared with the oral avicularium of *R. Beaniana*, and are destitute of the denticles.

The marginal spines seem to be only present on the youngest cells and colonies; in fully developed specimens they are, as far as I have seen, uniformly absent. The small oval or subcircular avicularia are scarcely present, if at all, on the front surface of the zoarium; they are replaced by the tongue-shaped appendages.

It is impossible to identify *R. reticulata* of the 'Cornish Fauna' by the description there given of it; and the synonymy is any thing but a trustworthy guide. At the time of the publication of the 'Fauna,' its author had not been able to obtain a Cornish specimen of it; and it holds a place in his work because it had been found in Scilly by Borlase. Many years after, however, I received from Mr. Couch himself a specimen of a *Retepora* which he had dredged off the Land's End, and which proved to

belong to the present species. Subsequently a large stone, dredged off Polperro, and sent me by Mr. Laughrin, yielded a small group of specimens referable to *R. Couchii*, as is also a minute fragment in my possession from some other part of the Cornish coast. All the south-western examples of *Retepora*, therefore, which have come under my observation belong to the present species; and it is probable, I think, that Borlase's specimen belonged to it also. *R. Couchii* has been taken in Guernsey. I know of no British specimen of *R. cellulosa*, Smitt, though it occurs both in Scandinavia and the Mediterranean.

Family XV.—Celleporidæ.

CELLEPORIDÆ, Johnston (part.): Busk: &c.

ESCHARIDÆ (part.), D'Orbigny.

MYRIOZOIDÆ (part.), Smitt, Flor. Bryoz.

ZOÆCIA calcareous, more or less vertical to the plane or axis of the colony, irregularly heaped together, with a terminal orifice.

IN his later writings Prof. Smitt has abandoned this family, and placed his genus *Cellepora* amongst the *Myriozoidæ*. I venture to think that there are sufficient grounds for its retention. The erect habit of the cells and the confused way in which they are aggregated are not the only characters which differentiate this section. The zoæcial characters, in my judgment, supply a good basis for the family, and, in combination with the vertical habit and the irregular gemmation, indicate a very natural group.

Genus CELLEPORA, part., *Fabricius*.

Der. From *cella*, a cell, and *πόρος*.

TUBIPORA (part.), Linnæus.

MILLEPORA (part.), Ell. & Soland.

CELLEPORA (part.), Fabricius, 1780: Linn.: Lamk. (part.): Lamx. (part.),
1816: Blainv. (part.): Johnston: Busk: &c.

CELLEPORARIA, Lamx. 1821: Reuss: D'Orbigny (for branched species).

SPONGITES, Oken.

MADREPORA (part.), Esper.

FLUSTRA (part.), Ell. & Soland.

REPTOCELLEPORARIA (sp.), D'Orb. (for incrusting species).

GENERIC CHARACTER.—ZOÆCIA *urceolate, erect or sub-erect, heaped together and irregularly disposed; the orifice terminal, with one or more ascending rostra in connexion with it, bearing avicularia. ZOARIUM incrusting, often composed of many layers of cells, or erect and ramose.*

THE species to which Fabricius applied the name *Cellepora* were, with a single exception, members of the old genus *Lepralia*. But that exception is the well-known *C. pumicosa*; and it has so happened that it has been taken as the type of his genus, and the name has passed into general use in connexion with the present group. In any case there would have been little ground for interfering with the common usage; and now that the genus *Lepralia* is dismembered, all pretext for such interference would seem to be removed.

a. *Orifice without a sinus; zoarium incrusting.*

CELLEPORA PUMICOSA, Linnæus.

Plate LIV. figs. 1-3.

"POROUS ESCHARA," *Ellis*, Corall. 75, no. 7, pl. xxvii. fig. f F.

CELLEPORA PUMICOSA, *Linn. Syst.* 1286: *Lamk. An. s. Vert. ed.* 2, ii. 256: *Flem. Br. An.* 532: *Johnston, Br. Zooph. ed.* 2, 295, pl. lii. figs. 1-3: *Busk, B.M. Cat.* ii. 86, pl. ex. figs. 4-6.

CELLEPORA VERRUCOSA, *Linn. Syst.* 1286: *Fabricius, Faun. Groenland.* 434: *Olivi, Zool. Adr.* 229.

MILLEPORA PUMICOSA (part.), *Pallas, Elench.* 254.

CELLEPORA SPINOSA, *Turton, Brit. Faun.* 205.

MADREPORA VERRUCARIA, *Esper, Madrep.* pl. xvii. figs. *c* C and *b* B.

Zoarium massive, scabrous, often nodulated, composed of many layers, of a pinkish colour when fresh. *Zoecia* subcylindrical or ovate, smooth, erect (except near the margin, where they are decumbent), crowded: orifice orbicular, with a thin raised peristome; in the centre, immediately below the inferior margin, a tall pointed rostrum, bearing on its inner aspect, towards the bottom, a large *avicularium* with broad triangular mandible, pointing upwards. *Oecia* small, semicircular, slightly recumbent, smooth; surface entire, or with a few rather large punctures on the front.

Polypide large and of a delicate orange colour.

HABITAT. On stones, shells, stems of zoophytes and of Algæ, &c., from beyond low-water mark to deep water.

LOCALITIES. Generally distributed.

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Pallas): Adriatic (Heller & Grube): Roscoff, common (Joliet): Finmark, 30-50 fathoms at Havösund; Bergen (Sars): Hougessund, North Sea, 5-20 fathoms (Kirchenpauer): Gulf of St. Lawrence (Dawson): mouth of the Jenesei (subfossil) (F. Schmidt): California (Dr. Sinclair): New Zealand, forming small white balls on *Sertularia* &c. (F. W. Hutton): Bass's Straits (Macgillivray).

RANGE IN TIME. Scotch Glacial deposits (Geikie): Manzoni gives this species a place in the Italian Pliocene fauna; but his description of the aperture, "*antice sinuata*," raises a doubt as to the accuracy of his identification. He at first referred the Pliocene form to *C. scruposa* (Busk), but subsequently to the present species.

C. pumicosa varies indefinitely in general appearance. Sometimes it forms small oval masses on the stems of zoophytes. When developed on the surface of shells &c., it takes the shape of a somewhat circular mound, raised in the centre, and sloping off towards the edge. Sometimes the surface of the zoarium is distinctly nodulous. Frequently it occurs in irregularly shaped porous masses of very considerable size, composed of many layers of crust placed one upon another, and involving more or less the fragment of shell or other body which constituted the original site of the colony. A specimen of this kind from Torbay measures $3\frac{1}{2}$ inches in length by $2\frac{1}{2}$ in width.

The cells in the older portions of the colony are perfectly erect, the apertures looking straight upwards; they are separated by spaces, which are occupied at a lower level by the orifices of other cells. The younger marginal zoœcia are decumbent, bright and silvery, and of delicate texture. The large and orbicular mouth, without any trace of sinus, and the strongly developed mucro in the centre of the lower margin (which encroaches slightly on the aperture), bearing a pointed avicularium at the bottom of its inner surface, are the most marked distinctive features. The total absence of the spatulate avicularia, which are so abundant on most of the other British species, is also a good (negative) character. The *mucro* varies considerably in size and proportions, but is commonly tall, and rises above the avicularium into a slender and sharply pointed spike. The avicularium itself is generally turned a little sideways.

The surface of the oœcium seems to be generally entire; but in some specimens it is punctured; the punctures are large, circular, reniform, or wedge-shaped.

A variety occurs in which the ovicells are not only punctured, but bear, in most cases, a rather large avicularium on each side, with a pointed mandible.

b. *Orifice without a sinus; zoarium ramose.*

CELLEPORA RAMULOSA, Linnæus.

Plate LII. figs. 7-9.

CELLEPORA RAMULOSA, Linn. Syst. ed. xii. 1285: *Flem. B. A.* 532: *Lamk. An. s. Vert.* ed. 2, ii. 258: *Couch, Corn. Faun.* iii. 110, pl. xx. fig. 2: *Johnst. B. Z.* ed. 2, 296, pl. lii. figs. 4, 5: *Busk, B.M. Cat.* ii. 87, pl. cix. figs. 1, 2, 3; *Crag Pol.* 58, pl. ix. fig. 2: *Alder, Quart. Journ. Micr. Sc.* (n. s.) iv. 96, pl. ii. fig. 1: *Smitt* (forma 3), loc. cit. 31 & 192. (Not *C. ramulosa* of Manzoni, *Bryoz. foss. Ital.*, Contr. iv. 12, pl. v. figs. 29, 29', and pl. vi. figs. 30, 30', 30'').

MILLEPORA PUMICOSA (part.), *Pall. Elench.* 254.

CELLEPORA PUMICOSA, var., *M. Sars, Reise i Lof. og Finm.* 27.

Zoarium erect, much and irregularly branched, rising commonly from a spreading base, branches cylindrical, or broad and somewhat compressed, dichotomous, usually tapering very slightly towards the extremity. *Zoæcia* ovate, smooth and glossy, elongate, slender, and regularly disposed in the younger portions of the colony; in the older prominent and ventricose, and irregularly placed; orifice suborbicular, with a thin raised peristome, a strongly developed rostrum below, generally produced into a sharp point, with an *avicularium* on one side of it, the base of which projects, like a spur, over the aperture (Plate LII. fig. 9), mandible acute, directed upwards: *spatulate avicularia* distributed occasionally amongst the cells. *Oæcia* subglobose, broader than high, smooth and silvery, often produced in front into a penthouse-like projection; surface generally entire, rarely punctured.

Polypide of a faint red or flesh-colour, with numerous tentacles.

Height 1 to 3 inches.

HABITAT. On the stems of Sertularian hydroids, shells, &c., chiefly from rather deep water.

LOCALITIES. Cornwall, 30 fathoms; South Devon;

Dogger bank (T. H.) : Guernsey ; Hastings (Miss Jelly) : St. Andrews, deep water (Dr. M'Intosh) : Shetland, 40–170 fathoms ; the Minch (A. M. N.) : between 62 and 72 fathoms off the Maiden Lighthouses, coast of Antrim (Mr. W. Swanston) : Belfast Bay (Hyndman) : Donaghadee, 8–10 fathoms (Dr. Drummond) : Youghal (Miss Ball) : 8 miles S.S.W. of the Mull of Galloway, 50 fathoms ; 5 miles S.W. of the same, 110–140 fathoms (Capt. Beechey) : off Sana Island, 40 fathoms (Hyndman) : &c.

GEOGRAPHICAL DISTRIBUTION. Norway, to the North Cape (Kirchenpauer) : Bohuslän, 50–60 fathoms (Lovén) : Bergen ; Finmark (Sars) : Roscoff (Joliet) : Madeira (J. Y. J.).

RANGE IN TIME. Coralline Crag (S. W.).

There are two marked varieties of this species—one slender and delicate, the other with broad, somewhat flattened branches, and altogether a stouter habit. At its origin, when developed on the various kinds of zoophyte, its favourite site, the zoarium surrounds and clasps the stems ; and then the erect shoots rise from all parts of the incrusting base. The branching is often luxuriant, and results in the formation of very pretty coral-like masses of considerable size. The surface of the zoarium appears rough and spinous.

The usual differences between the older and younger zoœcia occur in a very marked degree in this species ; in the latter a row of large punctures may be traced round the very base of the cell. The position of the oral avicularia on the side of the rostrum is one of the points which distinguishes this form from *C. pumicosa* ; another may be found in the presence (though rarely) of the large spatulate avicularia, which are always wanting in the latter.

Busk represents the ovicell as punctured, whilst Alder, on the other hand, describes it as imperforate. Both, I

believe, are, to some extent, right. In a large proportion of cases the surface seems to be entire; but I have met with cases in which it was rather thickly punctured. This character can hardly be relied on as a specific diagnostic. The raised peristome of the cell unites with the arch of the aperture of the ovicell, and gives the latter a hooded appearance. The projection in front of it is, I believe, generally present when the ovicell is fully developed, and gives it a very peculiar and picturesque appearance.

CELLEPORA DICHOTOMA, Hincks.

Plate LV. figs. 1-6, & 7-10 (var. *attenuata*).

CELLEPORA DICHOTOMA, *Hincks*, Devon & Cornw. Cat., Ann N. H. ser. 3, ix. 304 (49 sep.), pl. xii. figs. 7, 8: *Alder*, Quart. Journ. Micr. Sc. (n. s.) iv. (1864), 96, pl. ii. figs. 2-4: *M'Intosh*, Mar. Faun. St. Andrews, 48.

CELLEPORA ATTENUATA, *Alder*, Quart. Journ. Micr. Sc. (n. s.) iv. (1864), 97, pl. ii. figs. 5-8.

CELLEPORA RAMULOSA, forma AVICULARIS (part.), *Smitt*, loc. cit. 32.

CELLEPORA AVICULARIS, *Smitt*, Flor. Bryoz. pt. ii. 53, pl. ix. figs. 193-198.

Zoarium slender, narrowed towards the base and expanding upwards, dichotomously branched with great regularity, or of stouter habit, much and irregularly branched; branches sometimes cylindrical, slender, tapering, with a somewhat pointed extremity; sometimes broader, divided above into short blunt segments. *Zoæcia* ovate, ventricose, smooth, irregularly heaped; orifice suborbicular, with a thin raised peristome; below it a short, broad and blunt rostrum, with an *avicularium* on one side of it, mandible subtriangular. *Oæcia* globose, prominent, silvery, covered in front with raised punctures, united to the peristome. Numerous small, raised, *circular avicularia*, and frequently a considerable number of large *spatulate avicularia* distributed over the zoarium.

Height not exceeding 1 inch, generally less.

Var. *a* (*attenuata*, Alder). *Zoarium* slender and of uniform thickness throughout. *Zoæcia* less ventricose and crowded, and the surface consequently smoother and more even; *avicularia* more sparingly developed.

HABITAT. On zoophytes, chiefly from deep water.

LOCALITIES. Off Polperro, 30 fathoms (T. H.): Northumberland, not uncommon (Alder): St. Andrews, on zoophytes, abundant and fine (Dr. McIntosh): Wick and Peterhead (C. W. P.): Shetland, 40–70 fathoms; the Minch (A. M. N.): Oban; Ireland (T. H.). Var. *a* (*attenuata*). Shetland (Barlee): *ibid.*, “local, 80–110 fathoms, 20–25 miles N.N.E. of Unst” (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Florida, 9–111 fathoms (Pourtales).

In its smaller and more delicate form the habit of this species is very characteristic. It is at once recognizable by the simplicity of its dichotomous branching and the comparative smoothness of its surface. The stem, attenuated below, expands gradually upwards, and divides into two principal branches, which are bifurcate at the top. The ramification is commonly carried no further in this variety. The branches are slender, subcylindrical, and taper slightly towards the extremity; and the habit is essentially neat and compact. This is the form which commonly occurs on our south-western coasts.

But in northern examples *C. dichotoma* presents a very different character. It becomes irregular and rugged in its mode of growth; the ramification is more complex; the branches are often broad and spreading; and the species imitates to a large extent the habit of *C. ramulosa*. Occasionally the branches are much produced, forming tall, cylindrical and slender shoots; but in this form, as in the one last described, there is a total absence

of the simple regularity which characterizes the southern variety*.

In its minute characters *C. dichotoma* is very constant. The zoëcia are prominent and ventricose; and the rostrum below the aperture is uniformly short and blunt. The ovicells, with their silvery punctured surfaces, are a conspicuous feature, and are developed in great profusion; in some cases they are more or less covered by a dense white crust. They unite with the elevated peristome in front; and the aperture in the fertile cells is much contracted. Perhaps the most remarkable characteristic of this species in its ordinary state is the great development of the avicularian appendages, and the variety of form which they exhibit. Some are circular, of minute size, and placed on the summit of a small rising on the cell-wall, which must be regarded as representing the avicularian cell. These are present in very great numbers, sometimes as many as three occurring on a single zoëcium. The præoral avicularium has a subtriangular mandible; the rostrum on which it is placed is clearly the equivalent of the rising which bears the smaller form. The spatulate avicularia are often plentifully developed, but in some specimens occur more rarely. They are immersed and rather irregularly distributed; but one is frequently present beside the ovicell.

It can hardly, I think, be considered doubtful that the *C. attenuata* of Alder is a mere variety of the present species. The differences in habit are of the very smallest importance, and are not so great as those which exist between the stout and slender varieties of *C. dichotoma*, which I have just described. Mr. Alder himself mentions a variety of the latter "consisting of more slender cylin-

* "It varies a good deal in form, sometimes spreading in a palmate manner, like an elk's horn, sometimes consisting of more slender cylindrical branches of nearly equal thickness throughout. The typical form, however, is a little ventricose in the centre and not much branched."—ALDER.

drical branches of nearly equal thickness throughout." In the minute characters the two forms essentially agree: the only difference at all worth consideration is, that the cells are less ventricose and crowded in the *attenuata* variety, and the surface, as a consequence, smoother. But towards the extremity of the branches this character is less marked, and there is an approach towards the normal condition. The stems are in all cases comparatively smooth towards the bottom (*i. e.* in the older portions); and in the *attenuata* form a larger proportion of the zoarium seems to be in this state. I believe that this variety is more highly calcified than the normal form, and that the peculiarity in its appearance is partly due to this circumstance. I have already referred to the dense white crust which occasionally forms over *C. dichotoma*, and by which the ovicells are in some cases partially invested; and the variety seems to have undergone a similar change.

The small avicularia are present on *C. attenuata*, and exhibit exactly the same characters as on the normal *dichotoma*, but are somewhat less numerous. Mr. Alder seems not to have met with the spatulate avicularia at all; but though extremely rare in the specimens I have seen, they are not altogether absent. The peculiarities of *C. attenuata*, which he has noted with characteristic quickness and accuracy, are certainly those of a variety and not of a species.

c. Orifice with a sinus below; zoarium incrusting.

CELLEPORA AVICULARIS, Hincks.

Plate LIV. figs. 4-6.

CELLEPORA AVICULARIS, *Hincks*, Quart. Journ. Mier. Sc., Zoophytol. viii. 278; Proc. Dubl. Un. Zool. & Bot. Assoc. ii. pt. 1, 77; Devon Cat., Ann. N. H. ser. 3, ix. 304 (48 sep.), pl. xii. fig. 6: *Norman*, Shetland Pol., Rep. B. A. 1868, 308.

CELLEPORA RAMULOSA, forma AVICULARIS (part.), *Smitt*, Öfv. K. Vet-Akad. Förh. 1867, Bihang, 32 & 194, pl. xxviii. figs. 202 & 205*.

Zoarium incrusting, multiform, often nodulated. *Zoæcia* ovate, smooth, erect (in the older parts of the colony), crowded, irregular, the apertures showing at different levels on the surface; orifice orbicular above, with a pointed sinus below; peristome elevated, thin; beneath the aperture, and placed a little on one side of the sinus, a rather massive rostrum, bearing a large *avicularium* with pointed mandible, which is turned a little sideways. *Oæcia* prominent, subglobose, rather broader than high, with large punctures, frequently an ascending process on each side or on one side, a little in front, bearing a small *avicularium*, with a rounded mandible. Very large spatulate *avicularia* abundant, irregularly distributed.

HABITAT. Incrusting the stems and branches of zoophytes with thick nodulous rolls, on shells &c. from moderate to great depths.

LOCALITIES. South Devon and Cornwall, common, on Sertularians, *Gorgonia*, &c.; Oban (T. H.): Hastings (Miss Jelly): St. Andrews, occasionally (Dr. M'Intosh): Shetland, on zoophytes (A. M. N.): coast of Antrim (Hyndman).

GEOGRAPHICAL DISTRIBUTION. From Bahusia to Spitzbergen, pretty common, in moderate and abyssal depths (Smitt): Naples, 10 fms. (Waters): Le Have bank, lat. 42° 56' 5 N., long. 64° 51' 3 W., 45 fms. (Smith and Harger).

I believe that *C. avicularis* will be found to have a wide distribution; but hitherto it has been recognized in few

* *C. avicularis* resembles in many points the *C. Redoutei* of Audouin, figured in Savigny's 'Égypte'; but, if the figure may be trusted, the two must, I think, be accounted distinct. Apart from other differences, there are an order and regularity about the latter, which are certainly no characters of the present form. With our present knowledge of Audouin's species, we should not be warranted in identifying it with *C. avicularis*.

localities, having been passed over probably from its superficial resemblance to *C. pumicosa*. So far as habit and general appearance are concerned, it affords a striking illustration of the protean character of its tribe, the crust being moulded on the various substances which it invests. It incloses the stem and branches of zoophytes in a stony cylinder, which is often nodulated on the surface. I have in my possession a remarkable specimen, which forms a thick-walled tube about two inches in length, round the case of an annelid, and is covered with prominent papillæ. On shells the crust rises into mound-like masses, often with a mamillated surface; it is sometimes of very great thickness, and composed of many strata of cells. The cells are punctured round the edge; and in certain conditions of the zoarium this character is a very conspicuous one; they are also crowded and very irregularly placed. The sinus on the lower margin of the orifice is broad and pointed. When the ovicell is absent the peristome is very slightly developed; but in fertile cells it rises to a considerable height, and unites with the ovicell, walling in and concealing the primary aperture.

The surface of the zoarium offers a bewildering profusion of structure. Amongst the cells of the uppermost layer those of the one beneath it are more or less visible; and at all points there are multitudes of the large rostra, avicularia of various form and size, punctured ovicells, now prominent, now deeply immersed, all crowded together, as it were, without plan or order. The small lateral avicularia in front of the ovicell are often wanting; but they must be regarded as a characteristic feature of the species. The spatulate avicularia are developed in great quantity; they are met with on all parts of the zoarium, showing no regularity of arrangement, turned now in one direction, now in another; but in many cases they seem

to have more or less connexion with the ovicell. Occasionally stout conical rostra occur, apparently unconnected with a zoëcium, bearing very large avicularia, with broad triangular mandible.

CELLEPORA TUBIGERA, Busk.

Plate LIV. figs. 7-9.

CELLEPORA TUBIGERA, *Busk*, Crag Pol. 60, pl. ix. figs. 8 & 10: *Manzoni*, Bryoz. foss. Ital., Contr. iv. 14, pl. iv. fig. 25 (?).

Zoarium adnate, irregularly convex or subconical. *Zoëcia* distant, connected by ridges, sparsely punctured; orifice orbicular, with a sinus in front; cylindrical tubular processes supporting avicularia arising from the front or side of a cell, or from the intercellular ridges. [*Busk.*]

HABITAT. On shell, &c.

LOCALITIES. Britain, south and west coasts (*Busk*): Lamlash Bay, Arran (G. West).

GEOGRAPHICAL DISTRIBUTION. Coast of France (*Jeffreys*).

RANGE IN TIME. Coralline Crag, on shell (S. W.): ? Italian Pliocene (*Manzoni*).

I am only acquainted with this species through the description and figures in the 'Crag Polyzoa,' and have sometimes fancied that it might be identical with *C. avicularis*. It is difficult in this genus to form a positive opinion on figures taken from the fossil; the following, however, could hardly have been written of the last-named:—"Instead of the strong conical rostrum, with an avicularium on its inner aspect, so characteristic of *Cellepora pumicosa*, most of the cells are provided with slender subcylindrical ascending processes, having a small avicularium at or near the

summit" ('Crag Polyzoa,' p. 61). Nor could the cells of *C. avicularis* be correctly described as "distant, connected by ridges." I must leave the species to be illustrated by the study of recent examples.

CELLEPORA ARMATA, Hincks.

Plate LIV. figs. 10-13.

CELLEPORA ARMATA, *Hincks*, Quart. Journ. Micr. Sc. (n. s.) viii. 278, pl. iii. fig. 5; Proc. Dubl. Univ. Zool. & Bot. Assoc. ii. pt. 1, 77, pl. iii. fig. 5.

Zoarium adnate, forming a rather thin crust. *Zoæcia* large, distinct, ovate, ventricose, smooth, suberect, except near the margin; orifice orbicular, more or less produced and pointed below; peristome thin and raised; a stout subcylindrical rostrum below it, placed a little on one side, bearing an *avicularium* immediately under the apex, with a subtriangular mandible; large, raised, spatulate *avicularia* distributed in great numbers amongst the cells, the mandible generally directed inwards. *Oæcia* smooth, walls entire.

HABITAT. On shell, &c., probably from deep water.

LOCALITIES. Coast of Antrim (Hyndman): Hastings (Miss Jelly): Dogger bank, on mussel; Cornwall (T. H.).

GEOGRAPHICAL DISTRIBUTION. Algiers, on *Lepralia foliacea* (J. Y. J.).

This is a large-celled species, and in general appearance differs much from *C. avicularis*. Its structure is simple; it has neither the irregular and confused appearance of the latter nor the spinous character of *C. pumicosa*. The cells are distinct, not crowded together, and very ventricose. The præoral rostrum is short, subcylindrical, and blunt above, and immediately below the apex is placed

the avicularium, turned a little towards one side and looking upwards. The aperture is large, sometimes orbicular, sometimes slightly produced and pointed below, sometimes with a more decided sinus on the lower margin. Many cells occur in which it is simply orbicular. The spatulate avicularia, which are of very large size, in keeping with the zoœcia, are present in great numbers, and form a striking characteristic.

The discrimination of forms amongst the *Celleporæ* is a very difficult task, and it is necessary to make large allowance for the variability of the tribe; but the present seems to have the characters of a species.

CELLEPORA COSTAZII, Audouin.

Plate LV. figs. 11-14.

CELLEPORA COSTAZII, Audouin, Expl. (1826): *Savigny*, Égypte, pl. vii. fig. 4.

CELLEPORA BIMUCRONATA, Hass. Ann. N. H. vii. (1841), 367, pl. ix. fig. 1.

LEPRALIA HASSALLII, Johnston, B. Z. ed. 2 (1847), 304, pl. liv. fig. 3.

CELLEPORA HASSALLII, Busk, B.M. Cat. ii. 86, pl. cix. figs. 4-6; var. *a*, Quart. Journ. Micr. Sc. (n. s.) vi. 263, pl. xx. fig. 6: *Manzoni*, Bryoz. foss. Ital., Contr. iv. 17, pl. iv. fig. 22.

CELLEPORINA HASSALLII, Gray, B.M. Rad. 128.

CELLEPORARIA HASSALLII, Smitt, Öfv. K. Vet.-Akad. Förh. 1867, Bihang, 33 & 197, pl. xxviii. fig. 211.

Zoœcia ovate, smooth, irregularly disposed, decumbent in the younger portions of the colony, erect and crowded in the older, sometimes an umbo on the front of the cell, a little below the aperture; orifice ample, suborbicular, with a rounded sinus on the lower margin; peristome raised, an erect tubular process on each side, bearing on its summit a small oval *avicularium* facing towards the aperture, lower lip sometimes mucronate; large, raised, spatulate *avicularia* distributed amongst the cells, sometimes wanting. *Oœcia* recumbent, rounded, rather shallow, much broader than high, with an arched

rib on the front inclosing an area which is either punctured or furrowed, the margin of the aperture thickened. *Polypide* large, of a reddish colour, with about 14 tentacles. Colonies forming rather thick crusts, composed of several layers of cells, placed one upon the other.

Var. α (*tubulosa*). Peristome much raised, forming a sub-erect tubular neck to the cell, with a groove-like depression at the base of it. [Plate LV. fig. 13.]

HABITAT. On stones and shells, and on the stems of Algæ, Sertularians, and other zoophytes &c., from shallow (Laminarian region) to moderately deep water (36 fathoms).

LOCALITIES. Lulworth; Cornwall, on stones, 30 fathoms; Mount's Bay, on tangle; South Devon; Ilfracombe, off the Capstone; Isle of Man, Ramsay and Point of Ayr; Guernsey (T. H.): Ayrshire, on *Patella cærulea* (Landsb.): Shetland, rocks and roots of *Laminariæ*; the Minch (A. M. N.): Dublin Bay? (Hassall): S.E. by E. from Bamborough, 36 fathoms (Kirchenpauer): between tide-marks, on *Laminariæ*, &c., Bamborough (Alder): Peterhead and Wick, plentiful between tide-marks (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Madeira, without punctures on the ovicell (J. Y. J.): Bahusia, North Sea, a single colony on an Alga (Lovén): Bergen (A. M. N.): Hougessund, 5-20 fathoms (Kirchenpauer): France, S.W. (Fischer): Naples; Red Sea (Waters).

RANGE IN TIME. Italian Pliocene (Manzoni).

The marginal cells of the primitive layer, which can be well seen in specimens spreading over stone, are completely decumbent, and of a regularly ovate form. In old colonies, in which several layers are superimposed one upon the other, and the zoœcia are crowded together, they become erect or suberect, the body of the cell is hidden, and only the apertures are visible. The primary orifice

is orbicular, and there is a well-marked sinus below ; as growth advances, however, it is more or less concealed by the elevation of the peristome, which usually forms a thin and shallow rim or border round the front. In the very curious and interesting variety (*tubulosa*), the peristome is prolonged into a suberect tubular shaft, within which the orifice is deeply sunk. In this form the tubular extension of the peristome rises above the ovicell, which is situated behind it. In old specimens, in which the oœcia are freely developed, the species takes on a different and very picturesque appearance. In some cases the inclosed area on the front of the oœcium is perforated with large punctures ; in others it is simply furrowed. This is a trifling difference, the furrowed condition being probably due to the confluence of the pores.

The cells are smooth and generally dull and opaque ; but in some forms they are of a more delicate texture and almost hyaline.

Though the list of localities is comparatively small, *C. Costazii* is, I believe, a common species. It occurs abundantly on the stems of various Hydroid zoophytes, over which it spreads in minute colonies.

[*The following genus should have been placed amongst the Porinidæ, page 226.*]

Genus CELLEPORELLA, Gray.

Der. Dim. of *Cellepora*, a genus of Polyzoa.

GENERIC CHARACTER.—ZOÆCIA *suberect, the anterior extremity tubular and free, with a terminal circular orifice. No special pores. ZOARIUM (in the British species) incrusting.*

THIS genus includes one or two minute and inconspicuous species, which have the Porinidan cell, but are destitute of any striking character. They are deep-water forms, and so far have only occurred in the North.

CELLEPORELLA LEPRALIOIDES, Norman.

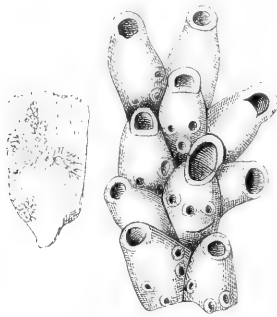
Woodcut, fig. 19.

CELLEPORELLA LEPRALIOIDES, *Norman*, Quart. Journ. Micr. Sc. (n. s.) viii. 222, pl. vii. figs. 4, 5.

Zoecia irregularly disposed, subcylindrical, elongated, semierect, upper portion free, surface rugose, large scattered punctures upon the sides; orifice nearly circular, terminal, opening upwards; peristome much raised.

Colonies forming small lobed patches.

Fig. 19.



Celleporella lepralioides.

HABITAT. On small pebbles from deep water.

LOCALITY. Shetland, 90–110 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.) : Greenland (North-German Polar Expedition).

CELLEPORELLA PYGMÆA, Norman.

CELLEPORELLA PYGMÆA, *Norman*, Shetland Polyzoa, Rep. Brit. Assoc. 1868, 308.

Zoæcia very small, short-ovate, decumbent below, suberect above, irregularly placed; surface smooth; orifice circular; peristome much raised, tubular, unattached all round. *Oæcia* rounded, depressed in front, imperforate.

Colonies forming small round patches, seldom more than $\frac{1}{10}$ inch in diameter.

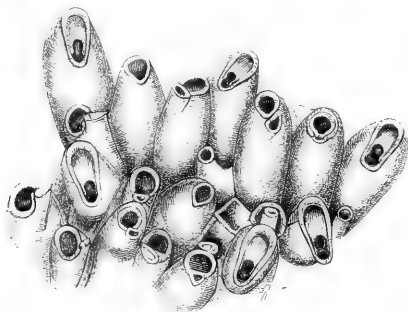
HABITAT. On stones from very deep water.

LOCALITY. Shetland, 80–170 fathoms, not uncommon (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.).

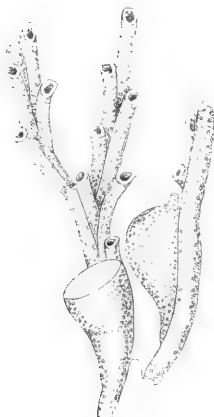
A minute and inconspicuous form, with few salient characters. The lower portion of the cell is short and subrotund; above it is produced into a rather tall cylindrical neck, which is suberect. The primary aperture is almost perfectly circular. The cells are distinct and somewhat ventricose below; and the surface is smooth and pearly white. The tubular peristome rises in front of the ovicell.

Fig. 20.



Colony of *Cellepore*.

Fig. 21.

*Crisia churnea.*Suborder II.—**CYCLOSTOMATA**, Busk.

CYCLOSTOMATA, Busk: Smitt: &c.

TUBULIPORINA, Milne-Edwards: Johnston: &c.

AULOPORINA (part.), Ehrenberg.

MYRIOPORINA (part.), Ehrenberg.

CERiopORINA (part.), Bronn.

CENTRIFUGINEA (part.), D'Orbigny.

Group i. *RADICELLATA*, D'Orbigny.

RADICELLATA, D'Orbigny (1850): Smitt.

ARTICULATA s. RADICATA, Busk (1859), Crag Polyzoa.

ZOARIUM erect, articulated, attached by radical tubes.

Family I.—**Crisiidæ.**

LES CRISIES, Milne-Edwards.

CRISIADÆ, Johnston &c.

CRISIDÆ, D'Orbigny.

CRISIIDÆ, Busk.

CRISIEE, Smitt.

CRISIDEA, Reuss, Bryoz. d. deutsch. Sept.

ZOARIUM dendroid, calcareous, composed of segments united by corneous joints. ZOÆCIA tubular, disposed in one or two series.

IN this family the polypide is small and of a simple type. When it is expanded, only the crown of tentacles protrudes beyond the opening of the cell; when retracted, the body is not doubled upon itself, but hangs straight within the cavity. There is no gizzard; the structure of the alimentary canal is perfectly simple. The number of the tentacles is eight; and they are clothed with extremely minute cilia.

The colony originates in a small disk-like body, with a calcareous covering, from which the primary cell is developed, jointed at the base. From the sides of the disk radical fibres are given off, which spread in all directions, attaching themselves to the base on which the colony is planted; these fibres are also jointed at intervals, and more or less branched. Besides these primitive rootlets other organs of attachment exist, in the shape of long fibrils, which originate at the base of the internodes, and, tending downwards, become adherent by means of lateral offshoots and serve as buttresses to the colony. On the lower portion of the shoot these fibrils are often extremely numerous, as many as four or five proceeding from a single internode. They are divided into segments by

corneous joints (which are frequently jet-black), and are often of very considerable length. In the upper portion of the shoots they are much more sparingly developed, and in this situation may perhaps act as tendrils.

The oœcia, amongst the *Crisiæ* and the Cyclostomata generally, differ widely from those of the Cheilostomata. They seem in the present case to be cells enlarged and modified for the simple discharge of reproductive functions, and may be regarded as homologous with the ordinary zoœcium of the Cheilostomata in its reproductive phase, *minus* the polypide. Smitt has studied their contents*, and traced the ovum through some of its changes into the larva. He has found no sign of spermatozoa in the ovarian chamber.

The *Crisiæ* are widely distributed, occurring in most parts of the world.

Fig. 22.

Structure of
oœcium.

Genus CRISIA (part.), Lamouroux.

Der. From *Crisia*, a daughter of Oceanus, according to Hesiod.

SERTULARIA (part.), Linn. &c.

CELLULARIA (part.), Pallas &c.

CELLARIA (part.), Ell. & Sol.: Lamk.: &c.

CRISIA, Lamx. (part.): Flem.: Blainv.: M.-Edwards: Johnston: D'Orbigny: Busk: Smitt: &c.

FALCARIA (part.), Oken.

EUCRATEA (part.), Fleming.

GENERIC CHARACTER.—ZOËCIA *in a single series, or in two alternate series.*

* "Om Hafs-bryozoernas Utveckling och Fettkroppar," Æfv. Kongl. Vetensk.-Akad. Förh. 1865, no. 1, pl. iv, figs. 1-8.

a. *With the cells in a single series.*

CRISIA CORNUTA, Linnæus.

Plate LVI. figs. 1-4.

- GOAT'S-POON CORALLINE, *Ellis*, Corall. 42, n. 10, pl. xxi. figs. c C.
 SERTULARIA CORNUTA, *Linn.* Syst. 1316: *Esper*, Pflanz. Sert. xix. figs. 1-3.
 CELLULARIA FALCATA, *Pallas*, Elench. 76.
 CELLULARIA CORNUTA, *Bruguère*, Encycl. Méthod. Vers, i. 442 & 453.
 CELLARIA CORNUTA, *Ell.* & *Sol.* 25: *Lamk.* An. s. Vert. 2nd ed. ii. 187
 EUCRATEA CORNUTA, *Lamx.* Pol. cor. flex. 149: *Flem.* B. A. 541.
 EUCRATEA APPENDICULATA, *Lamx.* Expos. Méth. 8, pl. lxxv. fig. 11.
 FALCARIA CORNUTA, *Oken*, Lehrb. Naturg. Zool. Abth. 2, 91: *Gray*, B.M. Rad. 137.
 UNICELLARIA CORNUTA, *Blainv.* Actinol. 461, pl. lxxvii. figs. 2, 2 a.
 CRISIA CORNUTA, *Johnst.* B. Z. ed. 1, 260, pl. xxx. figs. 1, 2: *Hassall*: *Couch*: *Smitt*: &c.
 CRISIDIA CORNUTA, *Milne-Edwards*, Recherches &c., Mém. sur les Crisies, &c. 11, pl. viii. figs. 2, 2 a, 2 b: *Johnst.* B. Z. ed. 2, 287, woodcut, fig. 63, pl. L. figs. 1, 2: *D'Orbigny*, Pal. Franç. terr. crét. v. 603: *Busk*, B.M. Cat. pt. iii. 3, pl. i. figs. 5-10: &c.
 CRISIA SETACEA, *Couch*, Zoologist, ii. 1096: *Johnst.* (*Crisidia*), loc. cit. 288.
 VAR. α (GENICULATA).
 CRISIA GENICULATA, *Milne-Edwards*, loc. cit. 5, pl. vi. fig. 1 (Ann. d. Sc. N. sér. 2, Zool. ix. 197): *Johnst.* B. Z. ed. 2, 286: *Gosse*, Dev. Coast, 435: *Sars*, Nyt Mag. f. Naturv. Bd. vii. 379.
 CRISIA CORNUTA α , sine cornibus, *Smitt*, Cefv. K. Vet.-Ak. Förh. 1865, no. 2, 115 & 126, pl. xvi. figs. 2, 3.
 FILICRISIA GENICULATA, *D'Orb.* Pal. Franç. loc. cit. 604.
 CRISIDIA CORNUTA, var. β , GENICULATA, *Busk*, B.M. Cat. pt. iii. 3, pl. i. figs. 1-4.

Zoarium forming very slender confervoid tufts, dichotomously branched. *Zoæcia* in a single line, curved inwards towards the upper extremity, attenuated downwards, free for a great portion of their length, slightly punctate, with a long jointed spine or bristle, springing from the side at a greater or less distance from the top; orifice circular. *Oæcia* axillary, oval, thickly speckled, with a tubular orifice at the top.

Height from $\frac{1}{4}$ to $\frac{1}{2}$ inch.

Var. α (*geniculata*). Without spines.

I HAVE followed Busk and Smitt in ranking the *Crisia*

geniculata of Milne-Edwards as a variety of the present species; indeed I have met with what seems to be a form or condition of *C. cornuta* which agrees with it in most respects. But if the two are identical, the distinguished French zoologist must have overlooked the jointed character of the zoarium, which is neither mentioned in his description nor shown in his figure. The regularity with which the zoœcia in *C. geniculata* are bent alternately in opposite directions, so as to give the stems a zigzagged appearance, has no parallel in the usual form of *C. cornuta*; but a similar arrangement occurs in the variety *setacea* of Couch. In the ordinary condition the cells are in a single line and all turned one way.

HABITAT. On Algæ, zoophytes, surface of rocks, shells, &c., from tide-marks to deep water.

LOCALITIES. Widely distributed. Cornwall (Couch): Scilly; Mount's Bay; South Devon; Swanage; Ilfracombe; Llandudno; Isle of Man; Filey; Oban (T. H.): Durham, south coast, common (J. Hogg): Wick and Peterhead (C. W. P.): Cullercoats (Alder): Shetland, tide-marks (A. M. N.), &c.

VAR. With the cells inclined alternately to opposite sides. Ilfracombe, on the underside of rocks (T. H.).

GEOGRAPHICAL DISTRIBUTION. Roscoff, on Algæ and various marine bodies at all depths (Joliet): Mediterranean (Pallas): Bahusia (Lovén): Norway (Sars).

b. *With the cells in two series.*

CRISIA EBURNEA, Linnæus.

Plate LVI. figs. 5, 6. Woodcut, fig. 21.

"TUFTED IVORY CORALLINE," Ellis, Corall. 39, no. 6, pl. xxi. fig. a A.

SERTULARIA EBURNEA, Linn. ed. 12, 1316: Jameson, Mem. Wern. Soc. i. 565 (1809).

- "SERTOLARIO D'AVORIO," *Cavolini*, Mem. d. Pol. mar. 240, pl. ix, figs. 5, 6.
- CELLULARIA EBURNEA, *Pallas*, Elench. 75.
- CELLARIA EBURNEA, *Ellis & Sol.* Zooph. 24 : *Lamk.* An. s. Vert. ed. 2, ii. 184.
- CRISIA EBURNEA, *Lamx.* Pol. corall. flex. 138 : *Flem.* B. A. 540 : *Johnst.* Br. Zooph. ed. 2, 283, woodcut, fig. 62, pl. 1. figs. 3, 4 : *Reid*, Ann. N. H. xvi. (1845), 385 : *Van Ben.* Recherches, Mém. Brux. xviii. 28, pl. iii. figs. 12-16 : *Milne-Edwards*, Ann. Sc. Nat. ii. Zool. 198, pl. vi. figs. 2, 2a (= var. *aculeata*): *Smitt*, (Efv. K. Vet.-Ak. Förh. 1864, 117 & 132, pl. xvi. figs. 7-19; var. *cornuta* (= *C. aculeata*, Hass.), loc. cit. 117 & 133: &c. &c.
- CRISIA ACULEATA, *Hassall*, Ann. N. H. vi. (1841), 170, pl. vii. figs. 3, 4 : *Johnst.* B. Z. ed. 2, 285.
- ? CRISIA PRODUCTA, *Smitt*, loc. cit. 116 & 131, pl. xvi. figs. 4, 5, 6.
- CRISIA HAUSERI, *Reuss* (*vide* Manzoni), Foss. Polyp. d. Wiener Tertiärbeck. 54, pl. vii. figs. 22-24; Fauna deutsch. Oberoligocän, ii. 54, pl. xv. figs. 6-8.

Zoarium forming small bushy tufts, of ivory whiteness, much branched, branches usually originating from the lowest cell in the internode, occasionally higher up, curled inwards. *Zoæcia* alternate, minutely speckled, more or less curved, almost entirely adnate, with a circular orifice very slightly bent forwards, frequently a pointed projection on the outer side; 3-9 cells in an internode; joints horn-coloured or (sometimes) black. *Oæcia* pyriform, adnate, thickly punctate, irregularly distributed, with a projecting tubular orifice in the adult state.

Height from $\frac{1}{4}$ to 1 inch.

Var. *a* (*aculeata*, Hassall). With a long, slender spine on the outer side of the zoæcia, near the top.

Var. *β* (*producta*, Smitt). *Zoæcia* more or less straight, elongated, the orifice directed upwards.

HABITAT. On Algæ and zoophytes (chiefly), stones, &c., from tide-marks to deep water (170 fathoms in Shetland).

LOCALITIES. Generally distributed on our coasts. Var. *α* (*aculeata*). Kingstown Harbour; Brighton (Hassall): Antrim, 47 fathoms (Swanston): Ayrshire (W. T.): Shet-

land (C. W. P.) : &c. Var. β . Shetland (A. M. N.). The position of this form (β) is doubtful: Busk makes it a variety of *C. cornuta*; Norman refers it to *eburnea*; Smitt places it between the two.

GEOGRAPHICAL DISTRIBUTION. Roscoff, on *Sargassum*, frequent (Joliet): France, S.W. (Fischer): Belgium (Van Ben.): the Little Belt, 16 fathoms; Hougesund (Kirchenpauer): Bahusia; Norway; Spitzbergen (Smitt): Greenland (Lütken): Nova Zembla, west, lat. $72^{\circ} 30'$, long. $52^{\circ} 45'$, in 5–20 fathoms; Möller Bay, 15–20 fathoms; Besimannaja Bay, 4–6 fathoms, &c.; Kara sea (Stuxberg & Théel): N. shore, St. Lawrence, 96 fathoms (Whiteaves): Hamilton's Inlet, Labrador, 15 fathoms (Wallich): St. George's banks, lat. $41^{\circ} 44' N.$, long. $64^{\circ} 36' W.$, in 60 fathoms (Smith & Harger): California (W. T.); Mediterranean (Pallas): Adriatic (Heller): Madeira (Busk): Teneriffe (D'Orbigny): New Zealand (Hutton): Australia (T. H.): Fiji Islands (Kirchenpauer). Var. α . Roscoff (Joliet). Var. β . Bohuslän, 5–10 fathoms, on Algæ (Smitt): Nova Zembla, 5–10 fathoms, on Algæ (Stuxberg & Théel).

RANGE IN TIME. Postpliocene, Montreal (Dawson): Palæolithic, British (A. Bell): Scotch Glacial deposits (Geikie): Austro-Hungarian Miocene (Reuss).

CRISIA DENTICULATA, Lamarek.

Plate LVI. figs. 7–9.

CELLARIA DENTICULATA, *Lamk.* Ann. s. Vert. ed. 2, ii. 182.

CRISIA LUXATA, *Flem.* B. A. 540: *Blainv.* Actinol. 460: *Couch*, Corn. Faun. pt. iii. 99, pl. xviii. fig. 3.

CRISIA DENTICULATA, *Milne-Edw.* Ann. Sc. Nat. sér. 2, Zool. ix. 201, pl. vii. fig. 1: *Johnst.* B. Z. ed. 2, 284, pl. 1. figs. 5, 6: *Busk*, Crag Pol. 93; B.M. Cat. pt. iii. 4, pl. ii. figs. 3, 4, pl. iii. figs. 1–6, pl. iv. figs. 1–4: *Smitt*, loc. cit. 117 & 137: &c. &c.

? CRISIA ARCTICA, *Sars*, Geol. og Zool. Iagttagelser (1863), 31.

? CRISIA ATTENUATA, *Heller*, Bryoz. Adr. M. 41, pl. iv. figs. 1, 2.

Zoarium forming large, dense masses, of a stout and erect habit, much branched, punctate; branches straight, broad, flattish, attenuated towards the base, originating from the fourth or fifth cell above the joint, sometimes from the second. *Zoæcia* semialternate, closely aggregated, elongate, nearly straight, almost entirely adnate; orifice elliptical, usually pointed on the outer side above, slightly bent forward, the internodes variable in length, but generally with numerous cells, sometimes as many as 16 or 17; joints usually jet-black. *Oæcia* oval, subpedicellate, thickly speckled, a tubular orifice at the top.

Height about an inch.

Var. *a.* *Zoarium* more slender; the *zoæcia* much longer, so that the orifices are much more distant from each other longitudinally, and appear less crowded; internodes usually of moderate length.

C. DENTICULATA is chiefly distinguished by its long, straight, broad and flattened internodes, on which the cells are closely packed together. In habit it is decidedly stout and erect.

HABITAT. In clefts and rock-pools near low-water mark, and on Algæ and zoophytes &c. from tide-marks to deep water.

LOCALITIES. Very generally distributed.

GEOGRAPHICAL DISTRIBUTION. Roscoff, on rocks, and especially on *Cystoseira fibrosa* (Joliet): Adriatic (Heller): Madeira; South Africa (Busk): Norway, 30–100 fathoms (Sars): Bahusia; Spitzbergen (Smitt): Kara sea (Stuxberg & Théel): Grand Manan, 10 fathoms (Stimpson).

RANGE IN TIME. Lower Suffolk Crag; Palæolithic (A. Bell): Scotch Glacial deposits (Geikie).

Group ii. *INCRUSTATA*, D'Orbigny.

CENTRIFUGINÉS EMPÂTÉS À CELLULES NON OPERCULÉES (part.), D'Orb. Pal. Franç.

INARTICULATA, Busk, B.M. Cat. pt. iii.

INARTICULATÆ SEU ADFIXÆ, id. Crag Pol.

INCRUSTATA, D'Orb.: Smitt.

ZOARIUM calcareous, continuous, not divided by corneous joints, or furnished with radical tubes; erect and attached by a contracted base, or recumbent and immediately adnate, either wholly or in part.

Family II.—*Tubuliporidæ*.

TUBIPORADÆ, Fleming.

TUBULIPORIDÆ, Johnston (part.): M.-Edwards (*les Tubulipores*): Busk: Smitt (part.): &c.

SPARSIDÆ (part.), D'Orbigny.

ZOARIUM entirely adherent, or more or less free and erect, multiform, often linear, or flabellate, or lobate, sometimes cylindrical. *ZOÆCIA* tubular, disposed in contiguous series, or in single lines. *OÆCIUM* an inflation of the surface of the zoarium at certain points, or a modified cell.

Genus *STOMATOPORA*, Bronn.

Der. From *στόμα*, the mouth, and *πόρος*.

ALECTO, Lamx. (1821 *): Blainville: Johnston: M.-Edwards: Busk: &c.

TUBULIPORA (part.), Lamk: Smitt.

STOMATOPORA, Bronn (1825): D'Orbigny (for uniserial species).

AULOPORA (part.), Goldfuss: Reuss.

PROBOSCINA (part.), Audouin: D'Orbigny: Smitt (subgenus).

DIASTOPORA (part.), Smitt.

GENERIC CHARACTER.—*ZOARIUM* *repent*, wholly adnate,

* Previously (1814) introduced by Leach for a genus of Echinoderms. As the name *Alecto* is still employed in connexion with the Crinoidea and is ordinarily associated with them, I am compelled to abandon it, which I do with much regret.

or free at the extremities, or giving off erect processes ; simple or branched ; branches more or less ligulate. ZOÆCIA in great part immersed, arranged in a single series or in several, which take a linear direction or are very slightly divergent.

THE distinction between this genus and *Tubulipora* is somewhat shadowy. In classifying the Cyclostomata we have to base our divisions mainly on habit or mode of growth, on the plan according to which the zoæcia are aggregated together into colonies ; the simplicity and general similarity of the cell throughout the tribe leave no other course open to us. We have to deal with very uniform structural elements very variously combined ; and the modes of combination chiefly supply us with the bases of our system. Under these circumstances, we may not expect very strongly marked boundary lines. *Stomatopora* is distinguished by its linear, adpressed, dichotomously branched zoarium, in which the cells are generally immersed for a great portion of their length, and are not divergent, except in a very slight degree, and then almost exclusively towards the very extremity of the branches. The most marked variation within the limits of the genus is found in the forms which have the zoarium partially free and erect. They constitute the subgenus *Proboscina* of Smitt.

a. *Zoarium entirely adherent.*

STOMATOPORA GRANULATA, M.-Edwards.

Plate LVII. figs. 1, 2.

ALECTO GRANULATA, M.-Edwards, *Mém.* 13, pl. xvi. figs. 3, 3a: *Johnst.* (part.), B. Z. ed. 2, 280 (pl. xlix. figs. 1, 2, are probably referable to *S. Johnstoni*): *Busk*, B.M. Cat. iii. 24, pl. xxxii. fig. 1, &c.

STOMATOPORA GRANULATA, *D'Orb.* Pal. Fr. terr. crét. v. 836, pl. dcxxviii. figs. 5-8 (*Alecto* on the plate).

STOMATOPORA INCRASSATA, *id.* ib. 837, pl. dcxxviii. figs. 9-11 (*Alecto* on the plate).

? ALECTO PARASITA, *Heller*, Bryoz. Adr. M. 49, pl. iii. fig. 10: *Manzoni*, Bry. d. Castrocaro, 41, pl. vii. fig. 69.

Zoarium dichotomously branched ; branches linear, sometimes anastomosing. *Zoecia* uniserial, minutely granular, the oral extremity more or less erect and free ; orifice circular. *Oæcia* (?).

HABITAT. On shells and stones, chiefly from deep water.

LOCALITIES. Cornwall (Couch) : Lee, near Ilfracombe, on *Laminaria*-roots (T. H.) : Hastings (Miss Jelly) : Northumberland and Durham, rather rare (Alder) : Wick and Peterhead (C. W. P.) : St. Andrews, not rare (Dr. M'Intosh) : coast of Antrim, abundant (Hyndman) : island of Coll, on *Pinna* (Landsb.) : Hebrides ; Shetland, Outer Haaf, to 170 fathoms, &c. (A. M. N.) : &c.

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet) : Bergen (A. M. N.).

RANGE IN TIME. Grès vert inférieur, France (Milne-Edwards).

In this species the cells are always disposed in a single series ; they are of about equal width throughout, or sometimes very slightly enlarged above, and altogether adnate, with the exception of the oral extremity, which is in a greater or less degree bent upwards, and stands erect and free. There is, however, much variability in the latter character ; and in old specimens, or such as have been developed in exposed situations, the orifice is often very slightly raised. The walls, in young and fresh colonies, are decidedly vitreous, and the whole surface is prettily frosted ; with age the walls become thick and opaque, and are sometimes strongly ribbed transversely.

The ramification, which is often luxuriant, and usually straggling and irregular, is simply dichotomous in plan; occasionally the branches meet and unite, and form a kind of network.

Johnston seems to have based his description of *S. granulata* on specimens of Milne-Edwards's species, and of the form which Heller has characterized as *Criserpia Johnstoni*. His figure must be referred to the latter.

STOMATOPORA MAJOR, Johnston.

Plate LVIII. and Plate LXI. fig. 1.

- ALECTO MAJOR, *Johnston*, B. Z. ed. 2, 281, pl. xlix. figs. 3, 4: *Busk*, B.M. Cat. iii. 24, pl. xvii. figs. 3 (very characteristic) to 5, ? pl. lvi. fig. 3: *Landsb.* Pop. Hist. 279, pl. xvi. fig. 60.
 ?TUBULIPORA TRAHENS, *Couch*, Corn. Faun. iii. 105, pl. xix. fig. 5.
 ?TUBULIPORA REPENS, *S. V. Wood*, Ann. N. H. xiii. 14: *Busk* (ALECTO), Crag Pol. 112, pl. xx. fig. 8 (not fig. 5).

Zoarium usually much branched dichotomously, walls minutely speckled or dense and smooth; branches rather straggling, stout, often radiating from a central point, widening gradually towards the top. *Zoæcia* disposed in 2-4 series, immersed, the oral extremity more or less erect and free, orifice circular; the free extremities sometimes arranged in very regular transverse rows, sometimes less regularly disposed. *Oæcia* developed at the end of the branches or immediately below the terminal bifurcation, somewhat elongate, broad above and narrowed downward.

IN the present form the branching is often luxuriant, and the most beautiful radiating growths are developed in the sheltered hollows of deserted shells (Plate LVIII. fig. 4); but, as is universally the case in this tribe, much diversity

in mere habit prevails. The branches are decidedly stout and somewhat depressed or flattened, widening gradually, and usually without any abruptness, towards the top. In a beautiful specimen, however, from Guernsey, which seems to be referable to this species, they terminate above in a triple or double division, and the extremities are rather more expanded than is usual (Plate LVIII. fig. 2). The zoœcia are in series ranging from two to three or even four; in some cases they are disposed with extreme regularity, and the orifices are placed side by side and form a line across the cell (Plate LXI. fig. 1). More commonly there is a certain amount of irregularity; frequently the cells are arranged semialternately, though still preserving their separate grouping. The arrangement of the zoœcia in more or less distinct series of 2-4 is one of the points that distinguish the present form from *S. dilatans*.

In the Guernsey specimen, before referred to, oœcia are developed immediately under the terminal tri- or bifurcations; in other cases they are placed close to the extremity of the branch. They consist of the usual inflation of the surface of the zoarium, in which a number of the tubes are involved.

In fresh specimens the surface is usually speckled; but states are of frequent occurrence in which the zoarium is dense and smooth.

HABITAT. On old shells and stones, chiefly from deep water.

LOCALITIES. Guernsey (A. M. N.): Cornwall (Couch): Isle of Man (T. H.): Northumberland, not common (Alder): island of Coll (Landsb.): Sana Island (W. T.): coast of Antrim, common; off the entrance to Belfast Bay, 25-35 fathoms (Hyndman): Shetland, common to 170 fathoms; Hebrides (A. M. N.): &c.

GEOGRAPHICAL DISTRIBUTION. Bergen (A. M. N.) : Roscoff (Joliet).

RANGE IN TIME. Coralline and Red Crag, on shell (S. V. Wood).

STOMATOPORA DILATANS, Johnston.

Plate LVII. figs. 3, 3 a.

ALECTO DILATANS, *Johnst.* B. Z. ed. 2, 281, pl. xlix. figs. 5, 6 : *Busk*, B.M. Cat. iii. 24, pl. xxxii. fig. 2 ; Crag Pol. 112, pl. xx. figs. 6, 7 ; *Landsb.* Pop. Hist. 280 : *Norman*, Shetland Dredging-List, Rep. Brit. Assoc. for 1867 (1868), 310.

? DIASTOPORA REPENS (part.), *Smitt*, loc. cit. 395 and 416, pl. viii. figs. 1-4.

? ALECTO REPENS, *Manzoni*, Bryoz. d. Castrocaro, pl. vi. fig. 72.

Zoarium entirely adherent, slightly ramified, consisting of a short stem, from which two or three long, widely divergent, serpentine branches originate, which sometimes bifurcate at the extremity ; branches convex, rounded, often constricted at intervals, enlarging towards the end, so as to assume a clavate form. *Zoecia* rather slender, laid closely side by side in many series (7-8 in the expanded portions), occupying the whole of the front of the branch, commonly alternate, punctate, vitreous, and of a delicate whiteness ; orifice raised, but usually projecting very slightly. *Oæcia* at the extremity of the branches.

THIS species differs from the preceding in its mode of branching, which is usually much simpler than that of *S. major*, in the character of its branches, which are long and serpentine, not depressed, and decidedly clavate at the extremities, and in the arrangement of the cells, which are slender, horizontal, not disposed in companies of two, three, or four, but packed closely together and occupying the whole front surface of the branch, slightly raised towards the orifice, and of singularly delicate texture. The branches are usually (so far as I have seen) few in

number, rather widely divergent, and of considerable length, and gradually dilate towards the top into a rounded expansion.

The basal lamina, by which the zoarium adheres, frequently forms an edging round it.

The largest specimen I have met with measured about $\frac{3}{8}$ inch across.

HABITAT. On stones and shells &c., from deep water.

LOCALITIES. Off Sana Island (Hyndman): coast of Antrim, 22 fathoms (Swanston): coast of Northumberland (W. King): off the Mull of Galloway, 110–140 fathoms (E. Forbes): Scotland, on *Pinna* (T. H.): island of Islay (Lady Emma Campbell): Shetland, 80–140 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): Scandinavian coasts, from great depths, on *Gorgonia*, *Oculina*, &c. (Smitt).

RANGE IN TIME. English Crag (Busk).

STOMATOPORA JOHNSTONI, Heller.

Plate LIX. fig. 1, and Plate LX. figs. 1, 1 *a*.

CRISERPIA JOHNSTONI, Heller, Bryoz. Ad. M. 50.

? ALECTO GRANULATA, Johnst. B. Z. ed. 2, pl. xlix. fig. 2.

Zoarium branched dichotomously, frequently white and vitreous, thickly speckled; branches slender, slightly expanded above. *Zoæcia* almost universally in series of 1–2. *Oæcia* at the extremities of the branches or at a bifurcation, dilated and very ventricose, wedge-shaped.

Var. *a. (robusta)*. *Zoarium* of somewhat stouter habit; branches broader, and rather more expanded at the extremities.

THE main characteristic of this species is the very slender habit, due to the disposition of the cells in series of 1-2 instead of 1-4, as in the preceding. In the lower portions of the branches they are often ranged in single line, the orifice rising alternately on opposite sides; above they form pairs, which are generally semi-alternate, or single cells and pairs follow in regular succession. I have only met with the oœcia in a single case; they form somewhat wedge-shaped and very ventricose enlargements at the extremities of the branches, and also at the bifurcation immediately below the terminal branchlets. A large number of tubes (as many as fifteen in one instance) are involved in them, and open out on the surface.

It is extremely difficult in this tribe to find valid specific distinctions; but the present form seems to have a fair amount of individuality, and can hardly be ranged under any of our other British *Stomatoporæ*. It is probably identical with the *Criserpia Johnstoni* of Heller; and though, in the absence of a good figure, the determination cannot be made with absolute certainty, I have thought it better to adopt his name*.

HABITAT. On shells and stones.

LOCALITIES. Guernsey (T. H.): coast of Antrim (Hyndman).

GEOGRAPHICAL DISTRIBUTION. On *Anomia*, Adriatic (Heller).

* Heller's diagnosis is as follows:—"Stock kriechend, verästelt, die röhrenförmigen Zellen zu zweien neben einander liegend, alternirend; Wandungen körnig."

STOMATOPORA EXPANSA.

Plate LXII. fig. 1.

? *PROBOSCINA RAMOSA*, *D'Orbigny* (= *IDMONEA CENOMANA*, *id.*), Pal. Franç. terr. crét. v. 851, pl. dextxxxiii. figs. 1-3.

Zoarium adherent, sparingly branched dichotomously, walls minutely punctulate and transversely rugose; branches moderately convex, generally short, narrow at the base, and rapidly widening out towards the extremity, broadly clavate in figure. *Zoæcia* somewhat irregularly distributed, not crowded together, erect, and free for a large portion of their length, increasing in number from one or two at the origin to seven or eight at the top of the branches. *Oœcium* an irregularly shaped inflation of the zoarium on the enlarged portion of the branches.

I do not venture to identify *S. expansa* with *D'Orbigny's Proboscina ramosa*, though it bears a strong general resemblance to it. The form which Smitt has referred to Wood's *Tubulipora palmata* agrees with it in the character of the ramification, but differs from it in having an extended continuous crust, from the edge of which the branches are given off.

The most striking character of this species is the form of the branches—which are short, and terminate above in rather broad clavate expansions. The orifices of the cells are occasionally obscurely rowed; but generally they are alternate or semialternate; there is little fixed order in the arrangement. The walls of the zoarium are of a dead white colour, and thickly covered with very minute puncta.

HABITAT. On dead shells.

LOCALITY. Isle of Man (T. H.).

STOMATOPORA INCURVATA, Hincks.

Plate LXIV. figs. 6-8.

TUBULIPORA INCURVATA, *Hincks*, Rep. Belfast Dredg. Com., in Rep. Brit. Assoc. 1858.

ALECTO INCURVATA, *id.* Proc. Dublin Univ. Zool. & Bot. Assoc. ii. pt. 1 (1860), 77; Quart. Journ. Micr. Sc. viii. (1860), 279, pl. xxx. fig. 6.

Zoarium adherent, linear, unbranched, curved, attenuated towards the point of origin, and of equal width above. *Zoecia* biserial (except towards the base of the zoarium, where they form a single row), alternate, separated by a median line, the walls usually much thickened, the oral extremity bent abruptly towards the side, the orifices opening out laterally; surface obscurely punctate.

Length of fine specimens rather more than a $\frac{1}{4}$ inch.

THIS species is at once recognized by its simple linear zoarium, which is always more or less curved, and is frequently very decidedly curled towards the base. The cells are normally biserial; but specimens not uncommonly occur in which only a single series is developed, and in all cases the basal portion of the zoarium is uniserial. They are disposed with much regularity, bending alternately and abruptly to opposite sides of the zoarium; the orifice, which is small, opens out laterally and is not at all visible when the specimen is viewed in front. The bent anterior portion of the cell is not free, but is adnate to the zoarium; it is often massive and somewhat quadrate in form.

As in others of the tribe, the zoarium originates in a small suborbicular disk or button, from which the first zoecium is developed.

HABITAT. On small stones from deep water.

LOCALITIES. Coast of Antrim, abundant (Hyndman): Guernsey (A. M. N.): Hebrides; off Caithness, deep water (C. W. P.).

STOMATOPORA DIASTOPORIDES, Norman.

Plate LXIII. figs. 3, 4.

ALECTO DIASTOPORIDES, *Norman*, Shetland Rep. in Rep. Brit. Assoc. for 1867 (1868), 310.

Zoarium lobulate, the branches diverging from a common centre, and rapidly widening into fan-shaped expansions, flat and closely appressed, punctate. *Zoecia* immersed, rather stout and elongate, irregularly scattered, crowded on the terminal enlargements, the tubes marked out by transparent lines; oral extremity usually very slightly raised. *Ozecia* (?).

THIS is the largest of the British *Stomatopora*, and has very much the look of a *Diastopora*. The zoarium is lobed; and in characteristic specimens branches diverge in all directions from a short and slender stem, and widen out above into broad flabellate extremities. These fan-shaped lobes usually form a very striking feature of the species. The transparent lines marking the boundaries of the cells are very distinctly traceable on the flat and depressed surface of the zoarium. The zoecial tubes are very large as compared with those of the following species.

HABITAT. On shell and stone from deep water.

LOCALITIES. Shetland, 70–110 fathoms (A. M. N.): Wick (C. W. P.): off the Maiden Lighthouses, co. Antrim, 62–72 fathoms (Swanston).

GEOGRAPHICAL DISTRIBUTION. Gulf of St. Lawrence (Dawson): off Hare Island, Waigat Strait, entrance of Baffin's Bay, 175 fathoms ('Valorous' dredgings).

STOMATOPORA COMPACTA, Norman.

Plate LXIII. figs. 1, 2.

ALECTO COMPACTA, *Norman*, Hebridean Polyz., Rep. Brit. Assoc. for 1866 (1867), 204.

Zoarium narrow at the base, rapidly widening above and ramifying irregularly, remarkably flattish and closely appressed, minutely punctate; branches wide and short, their extremities rounded. *Zoæcia* very small and slender, irregularly scattered and separated from each other, shortly tubular, the oral extremities scarcely raised above the surface, all inclining towards the top of the branches, but slightly bent towards the side. *Oæcia* (?).

In this species the primary stem often divides into two or three short and wide branches, which again divide and terminate in rounded segments. The zoarium is closely adnate and depressed, and always white in colour; the cells are small, and the whole habit delicate. This species, like the last, bears some resemblance to a *Diastopora*.

HABITAT. On stone and shell from deep water.

LOCALITIES. Hebrides, the Minch; Shetland (A. M. N.).

b. *Zoarium partially erect and free.*(Subgenus *Proboscina*, Smitt.)

STOMATOPORA INCRASSATA, Smitt.

Plate LIX. figs. 2, 3.

TUBULIPORA INCRASSATA (subgen. *Proboscina*), Smitt, loc. cit. 402 & 458, pl. v. figs. 1-7; Æfv. K. Vet.-Ak. Förh. 1871, 1119, pl. xx. fig. 8.

ALECTO RETIFORMIS, Hincks, Supplem. Devon & Cornw. Cat., Ann. N. H. ser. 4, iv. 81 (August 1871).

? FILISPARSA INCRASSATA, D' Orb. Pal. Fr. loc. cit. 817.

Zoarium white, minutely punctate, and often grooved transversely; much branched, the ramification compact; branches depressed, dichotomous, but not widely divergent, often of great breadth, expanding decidedly upwards, anastomosing freely, the reticulations generally elongate and pointed at both extremities. *Zoœcia* usually disposed without much regularity, sometimes two or three abreast, the anterior extremity erect and free. The *zoarium* frequently rises into short cylindrical processes with a cellular apex.

SPECIMENS of this fine and very characteristic species measure about an inch across, and form somewhat circular patches. In habit it is stout and compact; the branches lie rather close together, and meet and anastomose freely, so that the zoarium is always more or less retiform. The fenestræ are pretty uniform in figure; they are generally narrow-elongate, and produced into a point both above and below. The branches expand very rapidly upwards, and as they are placed near together, the projecting points above come into contact, and unite so as to form the meshes of the network. There is no regularity in the arrangement of the zoœcia, such as we meet with in *S. major*. The zoarium is always white. The tendency to form erect shoots is much more marked in some specimens than in others. At times the zoarium is studded over with

short cylindrical processes, most of them truncate at the top, which are situated just below the bifurcations. In their most fully developed state they are only slightly raised, and have a number of tubes projecting from the surface. I have referred the *Alecto retiformis*, mihi, to this species, though Smitt makes no mention of the anastomosing habit, which is so characteristic of the British form. D'Orbigny's *Filisparsa incrassata* may be the same thing; but his brief description leaves much room for doubt.

HABITAT. On shells from moderate depths to deep water.

LOCALITIES. Salcombe Bay, on a valve of *Pecten maximus*; Cornwall, on *Pinna*, from deep water; Scotland, also on *Pinna* (T. H.): Guernsey; Shetland (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Bohuslän, in great depths; Spitzbergen (Smitt): Nova Zembla; Kara Sea (Stuxberg & Théel).

STOMATOPORA DEFLEXA, Couch.

Plate LVII. fig. 4.

TUBULIPORA DEFLEXA, Couch, Corn. Faun. iii. 107, pl. xix. fig. 4.

PUSTULIPORA DEFLEXA, Johnston, B. Z. ed. 2, 279, ? pl. xlviii. fig. 5: *Hincks*, Devon Cat., Ann. N. H. ser. 3, ix. 306 (50 sep.); ? *Heller*, Bryoz. Ad. M. 49 (*Pustulopora*): *Busk*, B. M. Cat. iii. 22: *Joliet*, Bryoz. d. côtes de France, 94 (not *Entalophora deflexa*, Smitt, Flor. Bryoz.).

Zoarium in great part adherent, somewhat flattened, rather sparingly branched, minutely punctate; branches linear, expanding very slightly upwards, the extremities free, erect, subclavate, with waved tubes projecting from all parts. *Zoecia* slender, disposed in pairs along the creeping portion of the zoarium, and semialternate or distributed alternately, the oral extremity free, bent upwards, and projecting considerably. *Oecia* (?).

THE form here described, which is common on stones

and shells from the coast of Cornwall, seems to be the one on which Mr. Couch founded his *T. deflexa*. But if so, he has omitted all notice of the adnate and repent portions of the zoarium. His description and figure agree so exactly with the erect and somewhat clavate processes in which the creeping branches of the present species terminate, that I cannot but think that the latter may have escaped his notice. This seems the more probable, as this form is abundant on the coast where his researches were carried on; whilst, on the other hand, nothing more nearly resembling his *T. deflexa* has occurred there, so far as I know, to those who have followed him.

In the present species a number of slender creeping branches radiate from a common stem; and along these the tubular cells are ranged without much regularity, the series never exceeding two in number. Each of these branches terminates in a free portion, somewhat clavate above, at times expanding into an enlarged head, from all sides of which long curved tubes project. The zoarium is white and thickly speckled.

HABITAT. On shells and stones from deep water.

LOCALITIES. Polperro; Mevagissey Bay, and off the Deadman, common (Couch): Wick and Peterhead; Shetland (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet).

STOMATOPORA FUNGIA, Couch.

Plate LVII. figs. 5, 6.

TUBULIPORA FUNGIA, *Couch*, Corn. Faun. iii. 107, pl. xix. fig. 3: *Smitt* (subgen. *Proboscina*), loc. cit. 403 & 462, pl. x. figs. 2-5: *Busk*, B.M. Cat. iii. 26, pl. xxxii. fig. 3.

TUBULIPORA PENICILLATA, *Johnst.* B. Z. ed. 2, 270, pl. xlviii. figs. 1, 2 (not satisfactory): *Landsb.*, *Alder*, *Hincks*, &c. (probably not *Tubipora penicillata*, Fabricius).

Zoarium in great part repent and adnate, irregularly branched, giving off here and there erect fungiform processes, consisting of a stem which dilates above into a discoid capitulum, on the upper surface of which a number of tubular cells are disposed; creeping branches very stout, widening towards the extremities. *Zoæcia* slender, irregularly distributed on the branches, sometimes in clusters of three, the anterior portion free and usually projecting considerably; on the capitulum scattered, more thickly aggregated round the edge; orifice circular and plain.

Height of the erect fungiform processes rather less than $\frac{1}{4}$ inch.

IN the descriptions of this form which we have from Couch and Johnston the erect portions of the zoarium only are noticed; but these are merely the extremities of a creeping linear base, similar to that which we meet with in other members of this genus. The erect stalks, which bear the expanded head, have usually a few slender tubular cells projecting from the surface, though this is not universally the case; they are lineated longitudinally, and also traversed by transverse striæ.

The capitulum is a circular disk, usually somewhat convex above, but sometimes depressed in the middle; it is rather thick, and projects on all sides beyond the shaft of the stem. There is in some cases a narrow edging or rim round the head; the walls are minutely punctate. On its upper surface the tubes are generally ranged without much order (they are sometimes obscurely rowed), most thickly towards the edge, where they are placed almost horizontally, directed outwards; in the centre they are usually few in number and suberect.

The creeping portion of the zoarium resembles an ordinary *Stomatopora*: it is stout in habit, and has the cells

very irregularly and often thickly distributed over its surface.

In certain stages of growth, before the development of the discoid head, the erect stalks terminate above in a number of long, curved, irregularly disposed tubes. Busk's figure (B.M. Cat. iii. pl. xxxii. fig. 3) has the appearance of being drawn from an immature specimen.

The *Tubipora penicillata* of Fabricius differs from the present species in having the tubes towards the capitulum aggregated into fascicles, and disposed on its surface in radiating series. Smitt regards it as distinct, and has figured both forms from northern specimens. It must be noted, however, that his figure of *T. penicillata* bears a very close general resemblance to our West-of-England species; and as there is not unfrequently in *T. fungia* a tendency more or less marked towards a radiate arrangement of the zoëcia on the capitulum, it may perhaps be a question how far the separation of the two is warranted. In the absence of specimens of the *penicillata* form, the point cannot be determined.

HABITAT. On shells and stones generally from deep water.

LOCALITIES. From the Eddystone Lighthouse to the Deadman Point (Couch): on stone from 40 fathoms off Polperro; Torbay (T. H.): Wick and Peterhead (C. W. P.): Banff (Busk).

GEOGRAPHICAL DISTRIBUTION. Finmark, 50 fathoms (Goës and Malmgren): Greenland (Lütken): Hamilton's Inlet, Labrador (Wallich, *vide* Busk).

c. Colony clustered.

STOMATOPORA FASCICULATA.

Plate LIX. figs. 4, 5.

Zoarium adherent, composed of a number of clavate expansions more or less elongated, unbranched, and usually slightly curved, originating one from the side of another, and forming a cluster. *Zoæcia* immersed, generally only the orifices showing on the surface, and forming groups of 2 to 4 or 5, which are disposed along the centre of the zoarium, the extremities very slightly raised; at the end of each segment a subcircular cellular space, somewhat elevated; rarely the cells are ranged transversely in series of 3 to 4.

Length of each clavate portion about $\frac{1}{8}$ inch.

THE description is founded on a single example; but it is finely developed and leaves no doubt as to the distinctness of the form and its leading characters. It consists of a group of four perfect subcolonies, and a fifth which is only partially formed. Each of them is clavate in figure, with a sinuated outline; but they vary in width and length, one or two being of a shorter and broader type than the rest. The zoarium in the more elongated form is very convex, and the sides slope steeply upwards from the base towards the centre, along which the zoæcia are ranged; in the broader form the surface is flatter and more depressed. The mode in which these subcolonies are united is peculiar; each one is given off from the side of another, the point of origin being different in each case. From the primary subcolony two originate, one on each side.

The segments are attenuated towards the point of

origin, and widen gradually upward, terminating in a rounded and slightly expanded extremity: they constitute together a composite or clustered colony.

The zoœcia show a decided tendency towards a fasciculate arrangement; in most cases only the orifices are visible, and these are arranged in clusters of four or five together along the central line; groups of two are sometimes interposed; and towards the base of the subcolony there is only a single cell. In all cases the extremity is occupied by a large cellular area, almost circular in form, and somewhat raised. In one of the subcolonies the zoœcia are not collected in fascicles, but range in series of three to four across the zoarium. They are short and stout, and very slightly bent outwards at the top, and the boundary lines are distinguishable. In this instance there is a reversion to the arrangement which is usual in this genus; and in all cases, at the base of the subcolony the cells are disposed as in an ordinary *Stomatopora*.

The surface of the zoarium is dense and smooth, and of a dark brown colour.

In the character of the gemmation and the clustered condition of the colony, and in the disposition of the cells, this species stands alone amongst its kindred.

HABITAT. On shell, probably from deep water.

LOCALITY. Coast of Antrim (Hyndman).

Genus TUBULIPORA, *Lamarck*.

Der. From *tubulus*, a little tube, and *πόρος*.

TUBULIPORA (part.), Lamk. (1816): Johnston: Milne-Edwards: D'Orbigny:
Smitt: &c.

TUBULIPORA, Busk: &c.

CERIOPIORA (part.), Hagenow.

PHALANGELLA (sp.), Gray.

OBELIA (sp.), Lamouroux.

REPTOTUBIGERA, D'Orbigny.

GENERIC CHARACTER.—ZOARIUM *adnate or decumbent or suberect, forming a variously shaped expansion, either entire, or lobate, or branched. ZOECIA tubular, partially free and ascending, arranged in divergent series.*

A COLONY of *Tubulipora* originates in the small discoid body which constitutes the primary stage of most of the *Cyclostomata*. From this a single cell is developed, and from this a second, usually bent in the opposite direction; these are followed by an increasing number of series, which diverge more or less on each side. In some cases a simple flabellate crust is thus formed; in others it divides into lobes, which again subdivide. When the division and subdivision are carried to a great extent we have beautifully radiated specimens, in which the lobulate branches spread out circularly round the point of origin (Plate LXI. fig. 4 a).

In certain forms the primary flabellate expansion remains unbranched, or is simply bilobate, and as it increases bends backwards on each side, and ultimately incloses the primary disk, which becomes the centre of a somewhat circular colony. On this mode of growth the genus *Phalangella* of Gray is founded.

The cells in *Tubulipora* are generally (but not universally) free for a very considerable portion of their length.

I can see no sufficient ground for placing *Tubulipora* and *Diastopora* in separate families; the two genera are nearly related and have many common characters.

TUBULIPORA LOBULATA, Hassall.

Plate LXI. figs. 4, 5.

TUBULIPORA LOBULATA, *Hassall*, Ann. N. H. vii. 367, pl. x. figs. 1, 2: *Johnston*, B. Z. ed. 2, 272: *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 307 (51 sep.): *Smitt*, loc. cit. 400 and 454.

TUBULIPORA SERPENS (part.), *Busk*, B.M. Cat. iii. 25.

Zoarium closely adnate, lobulate, punctate, and of a dull purplish colour; branches often disposed radiately round a central point, usually short and broad, occasionally of a narrower and more elongate type, bifurcating slightly, and terminating in rounded lobes, which are sometimes dilated. *Zoecia* short, very stout, subcarinate in front, widening upwards; the orifice large and elliptical, and very slightly raised; seldom connate, crowded, and irregularly disposed, usually covering uniformly the whole surface of the branch; in the terminal expansions somewhat radiately arranged, or in longitudinal series, with distinct furrows between them; occasionally an obscure mesial line on the lower portion of the branch. The basal lamina expanded round the edge of the zoarium.

THIS form has been treated by some writers as a variety of *Idmonea serpens*; but it wants the distinguishing characters of the genus *Idmonea**. The habit is eminently characteristic. Well developed specimens usually assume a radiate mode of growth—a number of lobes, more or less branched, with rounded and often enlarged extremities, encircling a central point. In younger states the figure is flabellate. Varieties occur in which the branching is less regular, and the lobes are elongate, narrow, and

* The description of the present species is founded on a large series of specimens, dredged off the Isle of Man, where it is very abundant.

straggling, but the radiate form is the prevailing one. The cells differ widely from those of *I. serpens*. They are short and stout, and project very slightly from the crust. For the most part they are horizontal, and generally not connate, and they never form the deep, curved, transverse rows which are so characteristic of the last species. The dividing lines are generally absent, and the cells range in longitudinal series, covering uniformly the front of the branch. Sometimes, however, they are traceable on the front of the branches, but disappear altogether in the expanded terminations. In all cases the cells preserve their distinctive character. The orifice is large and elliptical.

The branches are thick and usually broad, not much subdivided, and of a dull purplish colour; the texture is much less delicate than that of *I. serpens*, and its bright, vitreous surface is wanting. The zoarium has a decidedly compact appearance, due to the shortness and horizontal position of the cells. The branches flange outwards towards the base, and are edged by an expansion of the basal lamina.

It may be added that the differences between the two forms are very apparent in the early stages of development.

HABITAT. On shells chiefly, from shallow to deep water.

LOCALITIES. Dublin Bay (Hassall): Isle of Man, off Maughold Head, extremely abundant; Torbay; Scotland, on *Pinna* (T. H.): Hastings (Miss Jelly): Shetland, on stone, 30-70 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Scandinavian coasts (Smitt).

TUBULIPORA FLABELLARIS, Fabricius.

Plate LXIV. figs. 1-3.

TUBIPORA FLABELLARIS, *Fabricius*, Faun. Grœnland. (1780), 430.TUBULIPORA FLABELLARIS, *Smitt*, Öfv. K. Vet.-Ak. Förh. 1866, 401 and 455, pl. ix. figs. 6-8: *Manzoni*, Bryoz. foss. d. Miocene d'Austria ed Ungheria, pt. iii. 14, pl. xii. fig. 50, pl. xiii. fig. 53.TUBULIPORA VERRUCARIA, *M.-Edwards*, Ann. Sc. Nat. ser. 2, viii. 323, pl. xii. fig. 1 (Recherches, &c., Mém. s. les *Tubulipores*, 3): *Heller* (? part.), Bryoz. Ad. M. 48.TUBULIPORA PHALANGEA, *Couch*, Corn. Faun. iii. 106, pl. xix. fig. 7: *Johnston*, B. Z. ed. 2, 273, pl. xlv. figs. 1-4: *Busk*, Crag Pol. 111, pl. xviii. fig. 6: *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 308 (52 sep.): *Busk*, B.M. Cat. iii. 25, pl. xxiii. &c.PHALANGELLA PHALANGEA, *Gray*, B.M. Rad. 139 and 149.DIASTOPORA PLUMULA, *Reuss*, Pol. Wien. Tertiärbeck. 51, pl. vii. figs. 11-13 (*vide Manzoni*).

Zoarium wholly adnate, of a pale purplish colour, suborbicular or obscurely lobed, when young flabellate. *Zoæcia* long, slender, somewhat flexuous, suberect, crowded, irregular, more or less connate, sometimes in simple series radiating from the centre to the circumference, sometimes (especially in the lobes) disposed in rows on each side of a mesial line, and inclining outwards; walls thin, vitreous, and punctate.

I QUITE agree with Prof. Smitt that this is the species described by Fabricius as *Tubipora flabellaris**; and undesirable as it undoubtedly is to interfere with the established nomenclature, it seems only right that the original application of the specific name should be restored.

* His words "*Tubipora* corallio . . . tubulis connatis radiato" and "unde in peripheriam ducuntur radii tubulis eminentibus simplici ordine connatis formati" could only apply to the present species. Busk thinks that Fabricius had both forms in view, probably because he applies the term "*flabelliformis*" to the zoarium. But such it commonly is in this species; it is only in its most perfect condition that it quite loses the fan-shaped figure.

T. phalangea of Couch and Johnston must therefore rank as a synonym of the older term.

There are considerable variations in the form of the zoarium in *T. flabellaris*. Generally the outline is more or less lobate, though the lobes are never strongly marked; but in some cases they disappear, and in the adult state the figure is simply orbicular; the lobes are usually five in number.

In fine, well developed specimens of this species the tubes are very long and flexuous, much crowded, and almost erect; they are sometimes disjunct for a considerable portion of their length; but more commonly they are connate, and form series of varying size. The centre of the zoarium is usually destitute of cells.

In an early stage *T. flabellaris* exhibits a simple bilobed form. In this condition the zoarium is stalked and divided into two rounded lobes, which are bent backwards from the point of division, so as to embrace the stalk, below which they finally coalesce. As growth proceeds other lobes are developed until the normal figure is completed. The stalk, with its attached disk, occupies in the adult the centre of the colony, surrounded and almost entirely concealed by the lobes.

To this species should probably be referred a remarkable *Tubulipora* which I have met with in old bivalve shells from Salcombe Bay. It forms large, somewhat circular, lobate masses, about an inch in diameter. The central portion is round, with sometimes as many as ten lobes, which are broad at the base, then gradually narrow for some way, and at the extremity expand into a clavate head. The heads vary in size, and occasionally coalesce; and in some cases the lobes are united throughout the greater part of their length, and we have a somewhat circular crust, with a very irregular and jagged outline. On the

central disk and the basal portion of the lobes the cells are arranged as in the normal *T. flabellaris*; on the enlarged heads they are disposed somewhat radiately. This curious variety, deprived of its terminal expansions, bears a striking resemblance to a Sun-Star (*Solaster*). In form and general appearance it is quite unlike the ordinary *T. flabellaris*; yet such is the tendency to irregularities of growth and habit in this section of the Cyclostomata that I do not venture to regard it as more than a very singular illustration of this characteristic.

HABITAT. On shells (especially inside old bivalves), Algæ, &c., in moderate depths.

LOCALITIES. Cornwall, 10–20 fathoms, common (Couch): South Devon (Salcombe Bay, in old scallop-shells, &c.), abundant (T. H.): off Whitehead, co. Antrim, 20 fathoms (Swanston): Shetland (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Bahusia (Lovén): Bergen (A. M. N.): Spitzbergen (Swed. Exped.): Greenland (Fabricius, and North-Germ. Pol. Exped.): ? South Labrador (Packard): Adriatic (Heller).

RANGE IN TIME. Coralline Crag (S. Wood): Austro-Hungarian Miocene (Manzoni): Scotch Glacial deposits (Geikie).

TUBULIPORA FIMBRIA, Lamarek.

Plate LX. figs. 3, 3a.

TUBIPORA SERPENS, *Fabr.* Faun. Grœnl. 429: *D' Orb.* loc. cit. 847.

TUBULIPORA FIMBRIA, *Lamk.* An. s. Vert. ed. 2, ii. 233: *M.-Edw.* loc. cit. 330, pl. xiv. fig. 2: *Smitt*, loc. cit. 401 and 452, pl. ix. fig. 5.

TUBULIPORA FLABELLARIS, *Johnston*, B. Z. ed. 2, 274, pl. xlvi. figs. 5, 6: *Landsb.* Pop. Hist. 274, pl. xv. fig. 50: *Busk*, Crag Pol. 111, pl. xviii. fig. 3, pl. xx. fig. 9; B.M. Cat. iii. 25, pls. xxiv., xxv.: *Alder*, North. Cat. loc. cit. 45 (sep.): *Hincks*, Ann. N. H. ser. 4, xix. 109.

? **PROBOSCINA LATIFOLIA**, *D' Orb.* Pal. Fr. terr. crét. v. 847.

Zoarium adnate, depressed, fan-shaped, sometimes with a lobate margin, minutely punctate, and often transversely rugose. *Zoecia* laid horizontally, semialternate, somewhat radiately (but not very regularly) disposed, of comparatively large bore, generally free for only a short distance towards the extremity, the free portion not standing erect, but taking the horizontal direction.

IN habit, as well as in the minute characters, this species differs very strikingly from the preceding, and it is difficult to understand the doubt which has been entertained as to their distinctness. *T. fimbria** is distinguished by its flat, fan-shaped zoarium (this form is characteristic of the adult), which is usually opaque, of a dull white colour, and strongly wrinkled transversely. The cells are not arranged in series, or at all connected together†; they are disposed somewhat irregularly, are slightly alternate, and spread out radiately over the flabellate expansion. They differ most markedly from those of *T. flabellaris* in being horizontal, and destitute of the very tall, suberect extremities which characterize the former. They are stout and transversely wrinkled, and have a plain orifice. The margin of the zoarium is frequently somewhat lobed; but the fan-shaped or plume-like figure is very constant.

T. fimbria seems to be a specially northern form.

HABITAT. On Algæ chiefly, shells, &c., in moderate depths and deep water.

LOCALITIES. Wick and Peterhead (C. W. P.): Northumberland, on *Fusus Norvegicus*, deep water, rare (Alder): Shetland (Peach, *fide* Alder): co. Down (W. T.).

* There seems to be room for doubt as to the identification of the present form with *T. fimbria*, although Milne-Edwards's figure of the latter, which was taken from a specimen labelled by Lamarck himself, certainly bears more resemblance to it. Under the circumstances, however, it is better to accept the decision, which is recommended by the authority of Professor Smitt, than to run the risk of needlessly introducing a new name.

† "Pagina . . . superiore tubulis solitariis obsita."—FABRICIUS.

GEOGRAPHICAL DISTRIBUTION. Greenland (Fabricius): Davis Straits, 100 fathoms; Hamilton's Inlet, Labrador (Wallich): Gulf of St. Lawrence (Dawson): Bahusia (Lovén): Spitzbergen (Swed. Exped.): west of Nova Zembla, lat. $72^{\circ} 30'$, long. $52^{\circ} 45'$, 5–20 fathoms (Stux-berg and Théel).

RANGE IN TIME. English Crag (S. Wood): Canadian Postpliocene (Dawson).

Genus IDMONEA, *Lamouroux*.

Der. From *Idmon*, one of the Argonauts.

IDMONEA, Lamx. Expos. Méth.: Blainville: Milne-Edwards: Johnston: Reuss: D'Orbigny (part.): Busk: &c.

RETEPORA (part.), Goldfuss: Lamk.

DIASTOPORA (part.), Michelin.

TUBULIPORA (part.), Lamk.

CRISINA (part.), D'Orbigny: Smitt.

TUBULIPORA, subgenus IDMONEA, Smitt.

GENERIC CHARACTER.—ZOARIUM *erect and ramose, or (rarely) adnate; branches usually triangular. ZOECIA tubular, disposed on the front of the branches, ranging in parallel transverse or oblique rows on each side of a mesial line.*

IDMONEA is most closely allied to *Tubulipora*, and must rank, I think, in the same family with it. Its erect habit, and more or less triangular branches, built up of tubes, the free extremities of which form transverse parallel rows, disposed subalternately on each side of a central line, give it a very characteristic facies; but such a form as *I. serpens*, which in its leading character is a true member of the genus, is a connecting link between it and *Tubulipora*.

In their adult state the *Idmoneæ* are attached by a somewhat expanded base, the surface of which is lineated or striated; but their earliest stage is, I believe, identical with that of *Tubulipora*. The two conditions may be readily observed in *I. serpens*, which may be found in its adnate and re-pent form with the primitive disk and the slender *Stomatopora*-like base, whilst in the suberect and radiate form, described hereafter, it is attached by a slightly spreading crustaceous base.

Fig. 23.

*Idmonea*, early stage.

The present genus has almost a world-wide range, and is represented by numerous species. Many charming forms occur in the Cretaceous deposits.

IDMONEA ATLANTICA, E. Forbes.

Plate LXV. figs. 1-4.

IDMONEA ATLANTICA, *Forbes*, MSS.: *Johnston*, B. Z. ed. 2, 278, pl. xlviii. fig. 3: *Gray*, B.M. Rad. 141: *Gosse*, Mar. Zool. pt. 2, 8, fig. 3: *Busk*, Ann. N. H. ser. 2, xviii. 34, pl. i. fig. 6 a-e; Quart. Journ. Micr. Sc. vi. 128, pl. xviii. fig. 5; Rep. Brit. Assoc. (1859), Trans. Sect. 146 (var. *tenuis*); B.M. Cat. iii. 11, pl. ix.: *Smitt* (subgen.), loc. cit. 398 and 434, pl. iii. figs. 6, 7, pl. iv. figs. 4-13; Flor. Bryoz. 6, pl. ii. figs. 7, 8 (slender form): *Manzoni*, Bryoz. d. Miocene d'Austria, pt. iii. 4, pl. ii. fig. 6.

IDMONEA RADIAN, *V. Beneden*, Bryoz. d. la Mer d. Nord, Bull. Brux. xvi. pt. 2, 646, pl. i. figs. 4-6.

?IDMONEA CORONOPUS, *DeFrance*, Dict. Sc. Nat. xxii. 565; *M.-Edwards*, Rech., Mém. sur les Crisies &c. 23, pl. xii. fig. 3.

?IDMONEA ANGUSTATA, *D'Orbigny*, Pal. Fr. terr. crét. v. 731.

Zoarium erect, white, punctulate, irregularly branched dichotomously; branches much in the same plane,

rising from a short stem, triangular, narrow, of great comparative thickness, tapering towards the extremities, and bifid; dorsal surface lineated and minutely punctate. *Zoæcia* 1-4 or 5 in each series, the innermost the longest. *Oæcium* prominent, somewhat pyriform, an inflation of the front surface of the branch, involving the neighbouring tubes.

Height about $\frac{3}{8}$ inch.

Var. *a* (*tenuis*, Busk). Branches extremely narrow; habit very slender.

THE variations to which this elegant species is liable are chiefly those of habit. A very slender variety (*tenuis*) occurs; and Busk records one from Madeira which is of greater size and more robust in its mode of growth than the northern form. There are also differences in the number of cells in a row; but they never seem to exceed four or five.

HABITAT. On corals, *Gorgonia*, Sertularian zoophytes, &c., chiefly from deep water.

LOCALITIES. Zetland seas (E. Forbes): Outer Haaf, 70-140 fathoms; Hebrides (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Naples, 40 fathoms, a single specimen (Waters): Hammerfæst, 12-20 fathoms (Sars): Grötsund, 50 fathoms (Goës and Malmgren): off Norway, 200 fathoms (Baron Uggla): off Frederickshaab, 100 fathoms (Wallich): entrance of Baffin's Bay ('Valorous' dredgings): Nova Zembla, Beluscha Bay, 30-70 fathoms; Kara Sea (Stuxberg and Théel). Var. *tenuis*. North Atlantic (Busk): Florida (Pourtales): Madeira (J. Y. J.).

RANGE IN TIME. Italian Miocene (Manzoni): Canadian Postpliocene (Dawson).

IDMONEA SERPENS, Linnæus.

Plate LXI. figs. 2, 3, and Plate LX. fig. 2.

SMALL PURPLE ESCHARA, *Ellis*, Cor. 74, no. 6, pl. xxvii., c, E.TUBIPORA SERPENS, *Linn.* Syst. Nat. ed. 12, 1271.MILLEPORA LILIACEA, *Pall.* Elench. 248.MILLEPORA TUBULOSA, *Ell.* & *Sol.* Zooph. 136.TUBULIPORA TRANSVERSA, *Lamk.* An. s. V. ed. 2, ii. 242: *Lamx.* Expos. Méth. 1, pl. lxiv. fig. 1 (after *Ellis*): *Blainv.* Actinol. 424: *Fischer*, Bryoz. du Sud-ouest de la France (1870), 10.IDMONEA TRANSVERSA, *M.-Edw.* Ann. Sc. Nat. sér. 2, ix. 218, pl. ix. fig. 3: *D'Orb.* Pal. Fr. terr. créét. v. 731.? IDMONEA DILATATA, *id.* loc. cit. 731.OBELIA TUBULIFERA, *Lamx.* Exp. Méth. 81, pl. lxxx. figs. 7, 8 (young state of the present species): (*REPTOTUBIGERA*) *D'Orb.* loc. cit. 752.? REPTOTUBIGERA CONFLUENS, *id.* loc. cit.TUBULIPORA FORAMINULATA, *Blainv.* Actinol. 425, pl. lxii. figs. 3, 3 a.TUBULIPORA SERPENS, *Flem.* B. A. 529: *Couch*, Corn. Faun. iii. 105, pl. xix. fig. 6: *Johnst.* B. Z. 2nd ed. 275, pl. xlvii. figs. 4-6: *Alder*, Northumb. Cat., Trans. Tynes. Nat. F. C. 1857, 46 (sep.): *Busk*, B.M. Cat. iii. 25, pl. xxii.: &c., &c.IDMONEA SERPENS, *Van Ben.* Bull. Ac. Roy. Belg. xvi. no. 12, 647 (5 sep.), pl. i. figs. 7-9: *Smitt* (subgen.), loc. cit. 399, pl. iii. figs. 1-5, and pl. ix. figs. 1, 2.

Zoarium either wholly adnate or attached by the base, the branches growing erect and free, composed of lobes which are dichotomously divided, slightly expanded and usually bifid at the extremities, of a purplish colour, vitreous and punctate, the dorsal surface striated longitudinally. *Zoæcia* disposed on the branches in prominent, oblique, semialternate series, more or less curved outwards above, usually connate, sometimes free towards the extremities, the cells in each series increasing in height from the outer side inwards.

Var. *a* (*radiata*). *Zoarium* regularly radiate in form, attached by a central disk, the branches disposed round it, free and suberect, generally bifid at the extremities.

THIS species varies much in appearance according to its

site. On shells it is commonly wholly adnate, and takes on many diverse shapes; but in the very beautiful variety *radiata* it adheres by a central disk only, around which the lobes or branches rise with much regularity. When attached to the stems of zoophytes it is almost entirely free and erect, and forms the prettiest coral-like growths. In its young state it assumes when repent a simple clavate figure, the zoarium, which is much attenuated towards the point of origin, expanding gradually towards the apex, and having the cells arranged in series on each side of the central line. In this condition it is the *Obelia tubulifera* of Lamouroux (Plate LX. fig. 2).

The delicate purplish colour and the bright vitreous surface are characteristic points. The branches terminate above in thick cellular extremities.

HABITAT. On old shells, zoophytes (especially *Hydrallmania falcata*), and Algæ, from the littoral region to very deep water.

LOCALITIES. Generally distributed. Var. *α*, on Cornish *Pinnæ* (T. H.).

GEOGRAPHICAL DISTRIBUTION. France, S.W. (Fischer): Roscoff, on Algæ, common (Joliet): Mediterranean (Lamx., Heller): Naples, 2 fathoms and 20-30 fathoms (A. W. Waters): Scandinavian coasts, Bahusia to Finmark, from the littoral region to very great depths (Smitt).

RANGE IN TIME. Scotch Glacial deposits (Geikie): Pliocene, Castrocaro (Manzoni): Sicilian Pliocene (Waters).

Genus ENTALOPHORA, *Lamouroux*.

Der. Named from the supposed resemblance of the zoëcium to the shell of *Dentalium entale*.

ENTALOPHORA, Lamx. (1821): D'Orbigny: Smitt, Flor. Bryoz.

PUSTULOPORA (part.), Blainville (1834): M.-Edwards: Lamk.: Busk: &c.

PUSTULIPORA, Blainville: Johnston: Gray.

GENERIC CHARACTER.—ZOARIUM *erect and ramose, rising from a more or less expanded base, composed of decumbent tubes; branches cylindrical. ZOECIA tubular, opening on all sides of the branches.*

ENTALOPHORA is nearly related to the section of the genus *Stomatopora* in which the branches have a tendency to grow upwards at certain points. In its young state it consists of an adnate tubular crust.

A question arises as to the name for this genus, though one might think a glance at the dates as given in the synonymy should settle it. Busk seems to admit that in strict propriety Lamouroux's designation is entitled to precedence; but he thinks that to restore it under the circumstances would savour of pedantry (Crag Polyzoa, p. 107). I confess it seems to me that the fewer departures from the established rule the better. The accidental prevalence of a much later name does not appear to be a reason for retaining it. On the contrary, it may be a salutary vindication of the authority of the law to reject it after such usurpation. The best cure for the disorders of our nomenclature seems to be a rigorous application of the principles which are generally accepted for its government. Lamouroux's genus is characterized in a well-known work; and both diagnosis and figure are sufficient for identification: its claim seems to be complete. I shall therefore follow D'Orbigny and Smitt in reinstating his name.

ENTALOPHORA CLAVATA, Busk.

Plate LXV. figs. 5-8.

PUSTULOPORA CLAVATA, *Busk*, Crag Polyz. 107, pl. xvii. fig. 1: *Peach*, Journ. Roy. Inst. Cornw. iv. (1871-73).

PUSTULOPORA DEFLEXA (part.), *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 306 (the specimen from Berry Head).

Zoarium with a short stem, branched dichotomously, surface minutely and thickly punctate, the puncta white, sometimes a cluster of erect shoots rising from the same base; branches stout, of much the same thickness as the stem, except towards the extremities, where they dilate considerably, and present a clavate figure, frequently dividing into a doublet or triplet of branchlets. *Zoecia* slender, usually projecting slightly below, above with a much larger portion free and flexuous, irregularly disposed; orifice circular and plain.

Height about $\frac{3}{8}$ inch.

THIS form, which has only occurred on our south-western shores and off the coast of Antrim, seems to be identical with Busk's *Pustulopora clavata* from the Crag. Its most marked characteristics are the decidedly clavate extremities of the branches, and the tendency to form triplets of terminal branchlets. In Torbay specimens the branches are thick, and of pretty uniform size up to the terminal division, from which they expand into very stout and short branchlets, usually three in number. In Mr. Peach's specimen from Cornwall the clavate expansions are not quite so massive, but are still a very conspicuous character.

The apex of the branchlets is cellular; and the lumina of the tubes on its surface sometimes number nearly forty.

In fine specimens as many as four or five erect and

branching stems rise from the same base, forming very beautiful clusters.

The Mediterranean *E. proboscidea*, M.-Edwards, is a larger species, of more slender habit, and wanting the clavate expansions, but very nearly akin to the present. It has not occurred in our seas, the specimens which Johnston referred to it being really *Palmicellaria elegans* of Alder. (See page 378.)

HABITAT. On shell, &c., shallow to deep water.

LOCALITIES. Wolf Rock, near Penzance (C. W. P.) : under Berry Head, Torbay (T. H.) : coast of Antrim, off the Maiden Lighthouses, 62-72 fathoms (Swanston).

RANGE IN TIME. Coralline Crag (S. Wood).

Genus DIASTOPORA (part.), Lamouroux.

Der. From διάστημα, an interval, and πόρος, a passage or opening.

BERENICEA, Lamouroux : D'Orbigny (for one section of the genus).

DIASTOPORA (part.), Lamx. : Smitt.

DIASTOPORA, Johnston : Busk : &c.

TUBULIPORA (sp.), Johnston : &c.

PATINELLA (sp.), Busk : Hincks.

MESENTERIPORA, Blainville : Busk : &c. (for foliaceous bilaminate forms).

DISCOSPARSA, D'Orbigny.

GENERIC CHARACTER.—ZOARIUM *adnate and crustaceous, or foliaceous, usually discoid or flabellate, less commonly irregular in form. ZOECIA tubular, with an elliptical or subcircular orifice, crowded, longitudinally arranged, in great part immersed.*

THERE seems to be no sufficient ground for detaching this group from the present family. In its early state *Diastopora* resembles *Tubulipora* ; and its peculiar habit

of growth is only a slight variation on that which we have in the section of the latter genus represented by *T. flabellaris*. It agrees with it in being destitute of cancelli; whilst in the comparatively depressed and immersed condition of the zoœcia it has a parallel in certain forms of *Stomatopora*.

The genus *Diastopora* has, however, on the whole, a very distinct facies. The expanded crustaceous mode of growth, the prevalent tendency to assume a discoid or flabellate form, the immersed and crowded condition of the (usually) slender zoœcia, are characters which combine to give it a very decided individuality.

The erect and foliaceous forms, which have been ranked under *Mesenteripora*, Blainville, are included in the present genus as here defined.

DIASTOPORA PATINA, Lamarck.

Plate LXVI. figs. 1-6.

TUBULIPORA PATINA, *Lamk.* An. s. Vert. ed. 2, ii. 244: *Blainville*, Actinol. 425: *Johnst.* B. Z. ed. 2, 266, pl. xlvii. figs. 1-3: *Gosse*, Mar. Zool. ii. 8, fig. 1: &c.

PATINELLA VERRUCARIA, *Gray*, Br. Rad. 138.

PATINELLA PATINA, *Busk*, Rep. Brit. Assoc. 1859, Trans. Sect. 147: *Hincks*, Dev. Cat. loc. cit. 468.

DISCOSPARSA MARGINATA (proliferous form), *D'Orb.* Pal. Fr. terr. crét. v. 822, pl. dcclvii. figs. 5-10.

DISCOSPARSA PATINA, *Heller*, Bryoz. d. Adr. M. 46.

DIASTOPORA PATINA, *Smitt*, loc. cit. 397 & 426, pl. viii. figs. 13-15: *Busk*, B.M. Cat. iii. 28, pl. xxix. figs. 1, 2, pl. xxx. fig. 1.

Zoarium discoid, circular, or (sometimes) elliptical, more or less cup-shaped, or flat and entirely adherent, surrounded by a rather broad extension of the basal lamina, forming a thin white border, transversely lineated. *Zoœcia* stout, minutely punctate, crowded, in the central portion of the colony immersed and closed, disposed in

radiating lines, towards the margin usually erect, open, sometimes connate, sometimes disjunct; orifice in the central cells subelliptical, plain, in the marginal cells suborbicular, often produced at one side, or bifid; the edge of the celliferous portion of the zoarium sometimes gemmiparous.

Disk in ordinary specimens about $\frac{1}{4}$ inch in diameter.

THE zoarium in this species, which is liable to many variations in shape, due to the nature of its site, is met with in two very distinct conditions. In one of them it is decidedly caliculate, the cup being of greater or less depth, and is as a consequence only partially adherent. It is attached by the centre of the basallamina, which is otherwise free, usually rising above the celliferous centre of the colony, and forming a thin, semitransparent wall around it. In this form the marginal belt of erect and open zoecia is generally well developed; but there is no uniformity in this respect, and in many cases almost all the cells in the colony are closed and entirely immersed.

The rule, however, holds good universally that the open cells, when present, occupy the marginal portions of the zoarium.

The zoecia are thickly punctate, and the puncta are present on the calcareous lid or operculum, which closes the orifice in a large proportion of them. The edge of the zoarium is somewhat thickened and cellular. In many cases the cup is deep and funnel-shaped, expanded above, and narrowing off to a fine point below (Plate LXVI. fig. 6); but it is very commonly shallow and depressed, and attached by a larger portion of the basal surface. This condition makes an approach to the second of the forms which the zoarium assumes in this species. In the latter the lamina is entirely and closely adherent, forming a

thin circular base, on which is placed the celliferous disk, either flat above, with the zoëcia wholly immersed, or depressed in the centre, and with a raised border of erect cells occupying the margin. In this state *D. patina* bears a much closer resemblance to its congeners than in its caliculate form (Plate LXVI. fig. 5).

Occasionally this species assumes a proliferous habit, and produces gemmæ freely. From Torbay and from deep water off the Cornish coast, I have obtained very beautiful specimens in this condition, bearing a number of young on the margin of the cup. In one case as many as five are present, occupying a large portion of the edge of the disk. The buds are developed just within the basal lamina on the cellular border.

In the finest proliferous specimens the cup is deep and funnel-shaped and stands erect, being attached by a very small portion of the base. It presents the same character in the *Discosparsa marginata* of D'Orbigny, which seems to be merely a proliferous form of the present species.

In some cases a thin calcareous crust involves the free and erect portion of the marginal cells, and forms a continuous inflation round the disk, which represents the œcium.

It is difficult to determine what the precise function may be of the closed cells, which occur in such numbers in every colony. Smitt has conjectured that they may be connected with the production of spermatozoa, and notes that in *T. patina* there is sometimes a small tubular opening in the cap or operculum, analogous to the projecting process in *D. Sarniensis**. It may be objected to this view that the closed cells are so numerous as to be out of

* Busk mentions "a minute central perforation" as occurring in the calcareous lid with which the cells are furnished in *Mesenteripora* ('Crag Polyzoa,' p. 110).

all proportion to the function assigned them; but it would be difficult to suggest a better interpretation, and it will do good service by giving direction to inquiry.

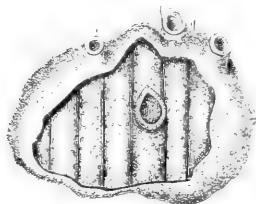
In an early stage of growth the zoarium bears much general resemblance to a young *Tubulipora*, consisting of a short stem, which originates in the usual circular disk, and a semicircular or somewhat flabellate lobe or expansion, covered with zoecia, and with a very broad laminar edging (Plate LXVI. fig. 2). Further development results in the extension of the lamina and celliferous crust around the primary germ, so as to form a circular discoid figure, of which it becomes the centre.

HABITAT. On shells, stones, Algæ, coral, &c., from almost all depths.

LOCALITIES. Very common. Cornwall, deep water (Couch): South Devon, abundant; Torbay (proliferous form) (T. H.): Northumberland (Alder): St. Andrews, deep water, especially on *Mytilus modiolus* (Dr. M'Intosh): Hebrides (A. M. N.): Shetland, to 170 fathoms, prolific form frequent (Barlee, Norman): Strangford Lough (W. T.): &c.

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): France, S.W. (Fischer): Adriatic (Heller): North and Arctic seas, 5-10 fms., on Algæ, *Flustra*, &c., on shells and coral, 50-100 fms. (Smitt): Bahusia (Lovén): South Norway (Lilljeborg): Finmark (Sars): South Labrador (Packard).

Fig. 24.



Zoecium of *D. Sarniensis*.

DIASTOPORA OBELIA*, Johnston.

Plate LXVI. figs. 10, 10 a.

TUBULIPORA OBELIA, *Johnst.* B. Z. ed. 1, 269, pl. xxxviii. figs. 7, 8.DIASTOPORA OBELIA, *id.* B. Z. ed. 2, 277, pl. xlvii. figs. 7, 8; *Smitt* (1865):
Busk: *Heller*: &c.DIASTOPORA HYALINA, a, OBELIA (*Johnst.*), *Smitt*, loc. cit. (1866), 396 &
421, pl. viii. figs. 9-12.

Zoarium entirely adherent, indefinite in its growth, and of irregular outline, edged by the basal lamina. *Zoœcia* arranged alternately, moderately slender, minutely punctate, surface flattened, usually with only a short portion of the anterior extremity free and suberect, separated by distinct, semitransparent lines; orifice sub-circular: small tubules (secondary cells) interspersed amongst the ordinary zoœcia. *Oœcia* transversely elliptical swellings involving several of the zoœcial tubes.

THE surface of the zoarium distinctly lineated by the boundaries of the cells, and the numerous tubules distributed amongst the zoœcia, are the features by which this species may be at once distinguished from the following. The cells are also less crowded than in *D. Sarniensis*.

The tubules are present in large numbers; they are very minute, and usually originate immediately behind the ordinary zoœcia, which they resemble closely in form. Their use is unknown.

The oœcium is very similar to that of the following species.

In some cases many of the cells are closed at the top; but they are never furnished with the tubular process which occurs in *D. Sarniensis*.

* This may be the *Berenicea hyalina* of Fleming; but his description is so little characteristic that the identification cannot be made with any certainty, and I therefore retain Johnston's well-established name.

HABITAT. On shell and stone, and occasionally Algæ, shallow to deep water.

LOCALITIES. Generally distributed on our coasts.

GEOGRAPHICAL DISTRIBUTION. Bahusia (Lovén) : Havö-sund and Bergen (Sars) : Spitzbergen, 6-20 fms., on *Laminaria* (Swed. Exped.) : Nova Zembla, Jugor-scharr, 10-14 fms. ; Matotschkin-scharr, 2-5 fms. ; Kara Sea (Stuxberg & Théel) : Greenland (Lütken) : off Bear Island (Dutch Arctic Exped.) : Gulf of St. Lawrence (Dawson) : Roscoff (Joliet) : Algiers (J. Y. J) : Adriatic (Heller) : Naples, 6 fms. and deeper (A. W. Waters).

RANGE IN TIME. Postpliocene, Canada (Dawson).

DIASTOPORA SARNIENSIS, Norman.

Plate LXVI. figs. 7-9.

DIASTOPORA SARNIENSIS, *Norman*, Ann. N. H. ser. 3, xiii. 89, pl. xi. figs. 4-6 :

Hincks, Suppl. Dev. Cat., Ann. N. H. ser. 4, viii. 81.

DIASTOPORA HYALINA (part.), *Smitt*, loc. cit. 396.

Zoarium forming an irregular crust, usually with a lobed and sinuated outline, milk-white, rather coarsely punctate, and often transversely striated, with a marginal extension of the basal lamina, and destitute of secondary cells or tubules. *Zoæcia* stout, disposed pretty regularly in lines radiating from the centre, generally free and suberect for a considerable portion of their length ; surface not depressed or flattened, boundary lines inconspicuous, often almost obliterated ; orifice elliptical, occasionally closed by an operculum, from the upper part of which a small tube projects. *Oæcia* transversely elongate, subelliptical inflations of the zoarium, of considerable size.

Zoarium sometimes $\frac{3}{4}$ inch in diameter.

THE crust is thick in *D. Sarniensis*, the edge cellu-

lar, and the basal lamina extends beyond it: it is commonly very distinctly rugose or striated transversely. The points in which it differs most markedly from *D. obelia* are the absence of the intercellular tubules, the indistinctness of the zoœcial outlines, the greater regularity in the disposition of the cells, and (generally) their more erect habit, and the presence of the closed cells with the projecting orifice.

The precise significance of the zoœcia (some of which are generally to be met with in each colony), which are operculate and furnished with the small tubular process at the top, is unknown. They have been considered to be subservient to reproduction, and to be equivalent to ovi-cells; but *D. Sarniensis* is furnished abundantly with oœcia of the usual character—a fact which must throw doubt on this interpretation (woodcut, fig. 24). Smitt's conjecture as to their function has already been referred to (page 460). Mr. Waters has described similar tubules as occurring on his *Reticulipora dorsalis* ('Annals' for April 1879, p. 278).

HABITAT. On shells, stones, &c., to deep water.

LOCALITIES. Off Guernsey and Jersey (A. M. N.): off Polperro, Cornwall, 40 fms. (T. H.): Lantivet Bay, Cornwall, on *Isocardia cor* (C. W. P.): Hastings (Miss Jelly).

GEOGRAPHICAL DISTRIBUTION. ? Red Sea or Mediterranean (R. S. Newall).

DIASTOPORA SUBORBICULARIS.

Plate LXVI. figs. 11, 11 a.

DIASTOPORA SIMPLEX, *Busk*, Crag Pol. 113, pl. xx. fig. 10: *Smitt*, loc. cit. 396 & 423, pl. viii. figs. 7, 8. (Not *Discosparsa* (*Diastopora*) *simplex* of D'Orbigny.)

DIASTOPORA OBELIA (part.), *Johnst.* B. Z. ed. 2, 270 (probably).

? DIASTOPORA FLABELLUM, *Reuss*, Pol. Wien. Tertiärb. 51, pl. vii. fig. 9*.

Zoarium thin, closely adnate, usually forming a suborbicular or elliptical crust. *Zoœcia* quincuncially arranged, very slender, thickly punctate, separated by distinct lines, upper surface flat, immersed, except at the extremity, which is rather abruptly bent upwards, the free portion usually short. *Oœcia* somewhat ovate, with a tube projecting at the top, speckled, disposed rather regularly at intervals round the zoarium, in successive series.

Fine specimens are about $\frac{1}{2}$ inch in diameter.

A LEADING characteristic of this species is the very definite and usually more or less orbicular shape of the zoarium. The number and regular arrangement of the oœcia, which are generally present, are also points that strike the eye at once. Morphologically these are modified cells, and form more or less ovate receptacles, with a tubular orifice. The crust is very thin and closely and entirely adherent, and without any extension of the lamina round it.

The zoœcia are elongate, slender, dotted over with white points, the surface flat, immersed almost throughout, but usually with the extremity erect and free. This character is always a very variable one. In the present species the tendency seems to be towards a more complete immersion of the cell than is usual; but in sheltered situations the free portion is often of considerable length. The boundary lines are conspicuous.

Busk describes the zoarium as either "orbicular or irregular;" but in all the specimens I have seen (and the species is abundant on the South-Devon coast), the shape

* Manzoni considers that this is probably identical with the present species. Busk, however, regards the identification as too doubtful to justify the adoption of Reuss's name.

is remarkably constant, and there is none of the indefiniteness in the mode of growth which we find in kindred forms. Regularity seems to be the prevalent characteristic.

In the original account of this species in the 'Crag Polyzoa,' the tubes are described as "not flattened in front," and this character is insisted upon as important. In the third part of the British-Museum Catalogue, however, they are merely stated to be "deeply and entirely immersed," and there is no reference to their convexity. In the form here intended the flatness of the cell is a marked character.

Mr. Waters has pointed out that the *Discosparsa simplex* of D'Orbigny belongs to this genus, and that Busk's name cannot be retained. There is too much doubt as to the identification with Reuss's *D. flabellum* to allow of the substitution of his name; and the only course therefore seems to be to give it a new one.

HABITAT. On shells and stones from shallow to deep water.

LOCALITIES. South Devon, abundant; Isle of Man (T. H.): Beaufort Dyke, 110-145 fms. (Capt. Beechey): Macgilligan, Ireland (W. T., *fide* Busk).

GEOGRAPHICAL DISTRIBUTION. Naples, 2-6 fathoms (Waters): Bahusia; Finmark (Lovén): Kara Sea (Stuxberg & Théel): Greenland (Lütken).

RANGE IN TIME. Coralline Crag, on shell (S. Wood).

Family III.—**Horneridæ.**

HORNERIDÆ, Smitt, Kritisk Fört. 1866.

CRISINIDÆ (part.), D'Orbigny.

LES TUBULIPORIENS (part.), Milne-Edwards.

IDMONEIDÆ (part.), Busk, Crag Pol., and B.M. Cat.

IDMONEADÆ (part.), id. Engl. Cyclopædia.

ZOÆCIA opening on one side only of a ramose zoarium, never adnate and repent.

Genus **HORNERA**, *Lamouroux*.

Der. Named after M. Horner, astronomer to the expedition round the world under Krusenstern.

MILLEPORA (part.), Linn.: Pallas: Solander: &c.

HORNERA, Lamx. (1821): Milne-Edwards (part.): D'Orbigny: Smitt: Busk: &c.

RETEPORA (part.), Lamk.: Goldfuss.

SIPHODICTYUM, Lonsdale.

GENERIC CHARACTER.—**ZOARIUM** erect, ramose, sometimes reticulate. **ZOÆCIA** tubular, opening on one side only of the branches, disposed in longitudinal series, the celliferous surface often traversed by wavy anastomosing ridges. **OÆCIUM** a distinct chamber (not a mere irregular inflation of the surface of the zoarium), placed dorsally or in front.

THE genus *Hornera* is connected with the *Tubuliporidae* through *Idmonea*, to which it bears in many points a very close resemblance. It embraces two very characteristic groups: in one the zoecia are covered in front by a calcareous crust, which takes the form of wavy longitudinal ridges, often anastomosing, which wind round and inclose the orifices of the cells, and give a fibrous appearance to the surface of the zoarium. Of this section, which may

be said to include the more typical species, we have an example in *H. lichenoides*. In the other group, of which *H. violacea* is a member, the superficial fibrous crust is wanting.

HORNERA LICHENOIDES, Linnæus.

Plate LXVII. figs. 1-5.

"CORALLIUM," *Pontoppidan*, Norges Naturl. Hist. i. 258, nos. 7 and 8, pl. xiv. figs. D, E.

MILLEPORA LICHENOIDES, *Linn.* Syst. ed. xii. 1283: *Ström*, Act. Hafn. xii. (1799), 309, pl. iii. figs. 1, 2.

HORNERA FRONDICULATA, *Sars*, Reise Lof. Finn., Nyt Mag. f. Nat. Vid. vi. 146: *Busk*, Ann. N. H. ser. 2, xviii. 34, pl. i. fig. 7.

HORNERA BOREALIS, *Busk*, Crag Polyz. 95 and 103: *Alder*, Quart. Journ. Micr. Sc. n. ser. iv. (1864), 103, pl. v. figs. 1-6.

HORNERA LICHENOIDES, *Smitt*, loc. cit. 404 and 469, pl. vi. fig. 10, pl. vii. figs. 1-14: *Busk*, B.M. Cat. iii. 17, pl. xviii. figs. 5, 6.

Zoarium white, rising from an expanded and furrowed base, much and irregularly branched, spreading, often somewhat flabelliform, the anterior surface fibro-reticulate, with scattered subtubular pores; branches rising from a very short stem, divided and subdivided dichotomously, so as to form somewhat fan-shaped segments, rather stout, very slightly compressed, tapering gradually towards the extremities, which are bifid. *Zoecia* on the front of the branches, immersed or very slightly prominent, the orifices quincuncially arranged, circular, with an even rim—those on the sides produced, expanded obliquely towards their extremities, the margin sometimes carried out into an acute point on one side; dorsal surface traversed by undulating ridges, with minute pores in the intermediate furrows. *Oecia* on the dorsal surface, ovate or suborbicular, sometimes very gibbous, reticulate, or coarsely punctate, with a tubular orifice on one side, from which a very slender rib stretches across to the opposite side.

Height from $\frac{1}{2}$ to $\frac{3}{4}$ inch; breadth about the same.

THE œcium in this species varies somewhat in position, but seems to be usually situated near the bifurcation of the branches, either immediately below the division, or at a short distance from it. It is sometimes extremely prominent, almost subconical, the sides being carried abruptly upwards to a central point; in other cases it is more depressed. The raised line or rib takes its origin near the free extremity of the tubular orifice, and passes from this point across the ovicell.

There is some difference in the mode of growth, and specimens occur which are comparatively tall (2 inches) and exhibit a straggling habit; but so far as I have seen, the compact and somewhat flabellate form is the more usual.

HABITAT. From moderate depths to deep water.

LOCALITIES. Shetland (Barlee): *ibid.*, Outer Haaf, 80–170 fathoms; Hebrides (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Waderöarne, Bahusia (Lovén): Norway (Pontoppidan, Ström, Sars (in about 40 fathoms), &c.): Nova Zembla (west), 20–30 fathoms; Kara sea (Stuxberg and Théel): Greenland (Lütken): St. George's Banks, 150 fathoms (Smith and Harger).

HORNERA VIOLACEA, Sars.

Plate LXVII. figs. 6–8, and Plate LXII. figs. 2, 3.

HORNERA VIOLACEA, Sars, Geol. og Zool. Iagtt. Reise Trondhj. St. 1862, N. Mag. f. Nat. Vid. xii. 282 (30 sep.): *Smitt* (forma *violacea*), loc. cit. 404 and 467, pl. vi. figs. 6–9: *Norman*, Shetland Dredg. Rep., Report Brit. Assoc. for 1867 (1868), 310: *Busk*, B.M. Cat. iii. 18, pl. xviii. fig. 1.

PUSTULOPORA ORCADENSIS, *Busk*, Quart. Journ. Micr. Sc. viii. (1860), 214, pl. xxxix. figs. 1, 2.

Zoarium irregularly branched; branches dichotomous,

short and truncate. *Zoæcia* crowded, distinct, generally a good deal produced, surface punctate; dorsal surface granular, the extremities of the branches with a rib-like elevation down the centre. *Oæcia* elongate, placed in the axils of the branches, partly on the front and partly on the back of the zoarium (chiefly placed on the back, but bent round the side of the branch towards the front), smooth, closely punctate, with a slight longitudinal costa; orifice bilabiate, situated near the top.

Colour, when fresh, white with a violet tinge.

Height from $\frac{1}{2}$ to $\frac{3}{4}$ inch.

II. VIOLACEA differs from the preceding species in the following points:—The front surface is not fibro-reticulate as in the last, the cells are somewhat longer, much more crowded, and more produced; the dorsal surface is granular, and on this side the branches are ribbed centrally towards the extremities; the oœcium is narrow and elongate, with a bilabiate orifice near the top, whereas that of *H. lichenoides* is ovate or suborbicular, much elevated, with a lateral and tubular aperture. The colour of the zoarium is also distinctive. The oœcium in the specimen from which the figure was taken (Plate LXII. fig. 3) was invested for some distance above the base by a thick calcareous crust, apparently continuous with the external layer of the zoarium. This crust extended round the sides of the ovicell, leaving the upper surface free.

I have not included amongst the synonyms the *Hornera violacea*, forma *proboscina*, Smitt, as, judging from the figure of the oœcium given in the Scandinavian Catalogue, it must be specifically distinct. The ovicell in this form is placed on the *front* of the branches, is round and flattened, and covered with large pores arranged in radiating rows.

HABITAT. On corals &c., in deep water.

LOCALITIES. Shetland, about 7 miles E.S.E. from Balta, in about 50 fathoms, rare (A. M. N.). Mr. Peach found it less uncommon in Shetland.

GEOGRAPHICAL DISTRIBUTION. Æsterraat, 70–80 fathoms; Christiansund, &c., 70–100 fathoms; Mauger, on *Oculina*, 150–200 fathoms (Sars): off Bergen (Höegh).

Family IV.—Lichenoporidæ.

DISCOPORADÆ, Busk, Brit. Cyclopæd.

CÁVEIDÆ (part.), D'Orbigny.

TUBIGERIDÆ (part.), id.

LICHENOPORIDÆ, Smitt.

DISCOPORELLIDÆ, Busk, B.M. Cat.

ZOARIUM *discoïd*, simple or composite, adnate, or partially free and stipitate. ZOÆCIA *tubular*, erect or suberect, disposed in more or less distinct series, which radiate from a free central area; the intermediate surface cancellated or porous.

Genus LICHENOPORA, Defrance.

Der. From *λειχήν*, lichen, and *πόρος*.

MADREFORA (part.), Fabr.: Esper.

LICHENOPORA, Defrance (1823): Blainville: Michelin: Smitt (1878).

DISCOPORELLA, Gray, B.M. Rad.: Busk: Smitt (1866).

DISCOPORA (part.), Flem.: Busk, Encyclopæd. Brit.

TUBULIPORA (part.), Johnston: auctt.

MELOBESIA, Audouin.

RADIOPORA, D'Orbigny (for species with confluent disks).

UNICAVEA (sp.), id.

DISCOCAVEA (sp.), id.

ACTINOPORA, id. (for adnate species with multiserial rays).

DISCOTUBIGERA, id.

HETEROPORELLA (sp.), Hincks.

GENERIC CHARACTER.—ZOARIUM *discoïd*, raised, simple,

or composed of many confluent disks, entirely adnate, or partially free, and sometimes stipitate, developed on a thin lamina, which usually forms a border round it. ZOECIA distinct or connate, in single radiating lines, or multiseriate.

D'ORBIGNY has constructed a large number of genera, which are merely arbitrary groups based on very trivial modifications of this well-marked type. Some of them are included in the synonymy of the present genus; and others might have been added.

The section in which the zoarium is made up of many confluent disks offers perhaps the most marked variation; but in such a species as *L. hispida* both the simple and complex conditions of the zoarium are of about equally common occurrence. The difference between the species which have the cells in one series and those which have them in two or more is of the very slightest moment; and therefore I have not thought it necessary to relegate *L. regularis* to the genus *Actinopora*, D'Orb. Still less ground is there for separating the forms which are wholly adnate from those which have the border free and raised and the zoarium somewhat cup-shaped.

The oecium is represented in *Lichenopora* by an inflation of the general surface of the disk, furnished with one or more tubular and (usually) somewhat trumpet-shaped orifices.

The genus is widely distributed both in space and time; in the Cretaceous beds it is represented by a large number of very beautiful forms.

1. *Colony simple ; or composed of many confluent disks.*
(Radiopora, *D'Orbigny*.)

LICHENOPORA HISPIDA, Fleming.

Plate LXVIII. figs. 1-8.

- DISCOPORA HISPIDA, *Flem.* B. A. 530 : *Blainv.* Actinol. 446 : *Couch*, Corn. Faun. pt. iii. 109, pl. xix. fig. 1.
 TUBULIPORA HISPIDA, *Johnst.* B. Z. ed. 2, 268, pl. xlvii. figs. 9-11 (bad).
 DISCOPORELLA HISPIDA, *Gray* (subgen.), B.M. Rad. 138 : *Busk*, Crag Polyz. 115, pl. xviii. fig. 5 ; *id.* B.M. Cat. iii. 30, pl. xxx. fig. 3 : *Smitt*, loc. cit. 406 & 483, pl. xi. figs. 10-12 : *Sars*; *Alder* & c.
 DISCOCAVEA (LICHENOPORA) ACULEATA, *D'Orbigny*, loc. cit. 958, pl. declxxvi. figs. 5-8.
 ? HETEROPORELLA RADIATA, *Busk*, Crag Pol. 127, pl. xix. fig. 2.
 HETEROPORELLA HISPIDA, *Hincks*, Dev. Cat. loc. cit. 469.

Zoarium closely adherent, or sometimes with the lamina turned up and the border free, subcircular and simple, frequently subconical ; or irregular in shape, often of large size, and composed of many confluent disks, the surface mamillated. *Zoecia* for the most part arranged in radiating series around a central space of larger or smaller size ; the orifices somewhat raised, tubular, the upper margin produced and often trifid, sometimes simply acuminate ; the interspaces between the rows, and the central area, covered with large circular stellate pores.

Polypide with 10 short tentacles, slightly everted at the extremities.

Var. *a* (*meandrina*, Peach). *Zoarium* composite, of large size, with the central spaces often elongate and winding or sinuous ; the orifice of the zoecia with a single slender mucro ; the pores large, forming " hexagonal depressions," and generally not stellate.

Var. *β*. *Zoarium* composite, the surface thickly covered with small oval mamillæ, somewhat regularly disposed ;

the central spaces very narrow, linear; *zoæcia* very slightly prominent.

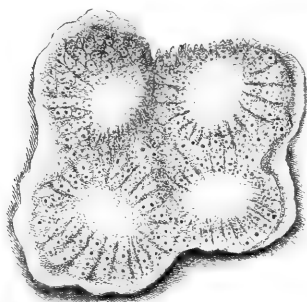
L. HISPIDA occurs in two very different conditions. The zoarium is either simple or composite, consisting of a single disk, which is generally suborbicular and often very convex, but occasionally more or less saucer-shaped; or of many disks united, so as to form rather large masses, with many papillary prominences studding the surface. In the saucer-shaped variety the edge of the basal lamina is free and suberect, and incloses the celliferous portion of the zoarium. In its more usual state the simple form is entirely adnate and a good deal raised, the cells radiate very regularly from the central space at the summit of the convex disk towards the margin, the orifices are but slightly elevated, and the upper margin is usually furnished with three spines, one central and of considerable length, and two lateral and shorter. The latter are often abortive, and the orifice is simply acuminate*. The pores (or ostioles) are smaller than the zoæcial apertures; they cover the central area, and are ranged in one or two lines along the interspaces. They are all but universally stellate.

The composite form seems to owe its origin to successive buddings from the margin (Plate LXVIII. fig. 4), the cluster of distinct disks thus produced gradually coalescing so as to constitute a massive zoarium, with a mamillated surface. Very beautiful specimens of this kind occur: I possess one from the Cornish coast which measures $1\frac{1}{2}$ inch in circumference, and is covered with about thirty of the characteristic eminences. The latter exhibit many diversities: in some cases they are very small, thickly

* In a young and beautifully developed specimen, I have noticed two small denticles placed one on each side in front of the usual triplet; in some cases the latter is replaced by two long spines of equal size.

crowded, oval in form, and with a very diminutive central space; in others the space at the summit is large and subcircular; in others, again, as in the var. *a*, elongate and often winding. Specimens of this composite growth present the most varied appearances. In the *meandrina*

Fig. 25.



Var. *meandrina*.

form the zoarium is generally a large, irregularly shaped crust, sinuated and contorted, and often displaying great unevenness of surface. The large straggling systems, in which the lines of cells are more prominent than is usual, also give it a very characteristic aspect; but I think it has no claim to be regarded as more than a very marked variety. Mr. Peach states that the ostioles want the stellate character which they exhibit in the normal *L. hispida*; and this is no doubt generally the case; but this difference is probably due to a peculiar state of the calcification.

In Mr. Peach's specimens the pores are in most cases partially filled in by a kind of diaphragm, which would conceal the minute denticles if present; but in rare instances I have detected them.

The variety β , with its very numerous, regularly dis-

posed, and diminutive systems, offers the most striking contrast to the last-named; but they are both referable to one and the same specific type.

HABITAT. On corals, Sertularians, shells, Algæ, &c., from moderate to great depths.

LOCALITIES. Guernsey; South Devon; Cornwall; Ilfracombe; Isle of Man; Rothsay Bay (T. H.): Northumberland, not rare (Alder): St. Andrews, rather rare (Dr. McIntosh): Hebrides; Shetland, to 170 fathoms (A. M. N.): &c. Var. *a*. Shetland, 80–100 fathoms (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. *Bahusia* (Lovén): Norway (Lilljeborg): Finmark (Sars): Greenland (Lütken): South Labrador (Packard): Roscoff, on *Eschara* (*Lepraria*) *foliacea* (Joliet): France, S.W. (Fischer).

RANGE IN TIME. ? Cor. Crag (S. Wood): Scotch Glacial deposits (Geikie): Postpliocene, Canada (Dawson).

2. Colony always simple.

a. *Zoëcia uniserial*.

LICHENOPORA RADIATA, Audouin.

Plate LXVIII. fig. 9, 10.

- MELOBESIA RADIATA, *Savigny*, Egypte; *Audouin*, Expl. 235, pl. vi. fig. 3.
 TUBULIPORA PATINA, *M.-Edw.* Recherches, Sur les Tubulip. 9, pl. xiii. fig. 1.
 UNICAVEA RADIATA, *D'Orb.* loc. cit. 971.
 ? DISCOCAVEA VERRUCARIA, *id.* loc. cit. 958.
 DISCOPORELLA FLOSCULUS, *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 468, pl. xvi. fig. 3.
 DISCOSPARSA PATINA, *Heller*, Bryoz. d. Adr. M. 46.
 DISCOPORELLA RADIATA, *Busk*, B.M. Cat. iii. 32, pl. xxxiv. fig. 3.

Zoarium orbicular, bordered with a thin, adherent lamina, convex, the centre of the disk flat, destitute of cells, cancellated, the openings of various size and shape, not stellate, frequently 1–3 large, trumpet-shaped, tubular

openings (oöcial apertures) placed near the margin of the central area. *Zoöcia* much raised, connate, disposed in uniserial radiating rows, alternately longer and shorter; orifice with the upper margin usually mucronate, and sometimes the lower also; one or two rows of rather large subcircular pores between the lines of cells.

Disk about $\frac{1}{8}$ inch in diameter.

THIS is a very pretty species, distinguished by the regularity of its radiation and the alternation of long and short rows of cells, which are uniserial and much elevated above the surface of the zoarium. The innermost tubes are the longest; and there is a gradual diminution in height towards the margin. The orifice is more or less strongly mucronate, and is often bifid.

The central area of the disk, which is of considerable size, has the appearance of being irregularly reticulate, and is covered with cancelli of very various shapes and sizes. The pores between the lines of cells are much larger, and more regularly formed; they are sometimes uniserial and sometimes disposed in a double row.

The zoarium, when attached to Algæ, is often much distorted, clasping and partly enveloping the stem, and loses its characteristic neatness and regularity of appearance.

The oöcia are formed by a general inflation of the upper surface of the disk, the trumpet-shaped processes being the orifices.

HABITAT. On shells, sea-weed, &c., from moderate depths and (?) deep water.

LOCALITIES. South Devon, Brixham, Salcombe, &c. (T. H.).

GEOGRAPHICAL DISTRIBUTION. Mediterranean ('Porcupine' Exped.): Adriatic (Heller): Naples, common on

Laurencia papillosa and other weeds, shallow water (A. W. Waters).

RANGE IN TIME. Pliocene, Brucoli (A. W. Waters).

LICHENOPORA VERRUCARIA, Fabricius.

Plate LXIV. figs. 4, 5.

MADREPORA VERRUCARIA, *Fabr. Faun. Grœnl.* 430: ? *Linn. Syst. ed. x.* 793.

? TUBULIPORA HISPIDA (part.), *Johnst. B. Z. ed. 2,* 268.

? DISCOSPARSA HISPIDA, *Heller, Bryoz. d. Adr. M.* 47*.

DISCOPORELLA VERRUCARIA, *Smitt, loc. cit.* 405 & 479, pl. x. figs. 6-8, pl. xi. figs. 1-6: *Busk, B.M. Cat. iii.* 31, pl. xxviii. figs. 2, 3.

LICHENOPORA VERRUCARIA, *Smitt, Bryoz. Nova Zembla, Gêfv. K. Vetensk. Ak. Förh.* 1878, no. 3, 15.

Zoarium subcircular, very convex, at times subconical, with a small central area destitute of cells, the laminar border narrow. *Zoæcia* rather stout, moderately raised, disposed more or less regularly in radiating lines, not connate, frequently traversed by longitudinal ribs; orifice obliquely elliptical, the margin carried up into a tall acuminate process; cells round the border of the disk not elevated, quincuncial, orifice subcircular. *Oæcium* an inflation of the surface of the disk; orifice trumpet-shaped.

THIS is a small species, with the zoarium always simple, and the cells, which are proportionally large, disconnected and arranged in short, radiating rows. The orifice is for the most part elliptical, and the upper margin is elevated and acuminate; occasionally the peristome is bifid. The zoæcia are generally buttressed in front by longitudinal ribs, which are sometimes serrate.

* It is a matter of extreme difficulty to determine the synonymy with any certainty in this section of the Cyclostomata. Heller identifies his species with the *M. verrucaria* of Fabr.; but his diagnosis is quite insufficient.

As Busk has already pointed out, Smitt has wrongly referred *D. flosculus*, n. sp. to the present species.

The central part of the disk and the interspaces between the rows of cells are cancellated or pierced by numerous pores; but this portion of the structure is very often concealed by the oœcial inflation (formed of a thin calcareous crust), which generally occupies the whole of the upper surface and incloses the erect tubes, so as to diminish their apparent height.

The oœcial orifices, according to Smitt, range from 1 to 8; very commonly there is only one.

L. verrucaria is a northern, and specially an Arctic form.

HABITAT. On *Laminariæ*, stems of zoophytes, &c., from moderate depths (15 fathoms) to deep water.

LOCALITIES. Orkney (Barlec): Arran (Busk): Co. Down (Hyndman).

GEOGRAPHICAL DISTRIBUTION. Bahusia (Lovén): Norway (Lilljeborg): Finmark (Sars): Davis Strait, 100 fathoms; Reykjavik, 15–20 fathoms; Hamilton's Inlet, Labrador (Wallich): Assistance Bay, Greenland (Sutherland): Bay of Fundy (Packard): St. George's Banks, 150 fathoms (Smith and Harger): Nova Zembla, lat. 70° 30', long. 52° 45', in 5–20 fathoms; Matotschkin-scharr, 2–5 fathoms, &c.; Kara sea (Stuxberg and Théel).

b. *Zoæcia multiseriæ*.

LICHENOPORA REGULARIS, D'Orbigny.

Plate LXVIII. fig. 11.

ACTINOPORA REGULARIS, *D'Orb.* Pal. Franç. terr. crét. v. 763, pl. cccxiii. figs. 7–9.

Zoarium entirely adnate, suborbicular, or somewhat elliptical, flat above, with a slight depression in the centre, a rather broad cellular margin sloping up to the rays.

Zoæcia multiserial, not raised above the surface, disposed in regular radiating rows, which taper off towards the centre, consisting of about three cells in the widest part, orifice plain; short rays intercalated at intervals amongst the rest.

The longer diameter $\frac{3}{8}$ inch, the shorter rather less.

THERE seems to be no essential difference between the Shetland form, on which this description is founded, and the Cretaceous species described by D'Orbigny as *Actinopora regularis*. The latter, as figured in the 'Paléontologie,' is of rather smaller size than the recent specimen, and seems to be in an earlier stage of development; it has a larger number of the short rays, but in all important characters it agrees with the present.

The zoarium is raised and somewhat mound-like, the upper surface flat, very slightly depressed in the centre; and from this point the longer lines of cells radiate with much regularity towards the circumference, widening gradually as they approach it. There is no extension of the lamina round the disk; but a thick and compact cellular border slopes up from the base of the zoarium to the circle of celliferous rays. The latter number about twenty-four in the Shetland specimen. The cells are not free for any portion of their length; but the orifices open out uniformly on the surface of the rays. The shorter series are few in number.

This is a fine addition to our British fauna—one of the many which we owe to the energetic labours of our Shetland dredgers, and doubly interesting as the survivor of so many important changes in the condition of our globe.

HABITAT. On stone, probably from deep water.

LOCALITY. Shetland (A. M. N.).

RANGE IN TIME. French Cretaceous deposits at Sainte-Croix, Vaud (D'Orbigny).

Genus DOMOPORA, D'Orbigny.

From *δóμος*, a dwelling, and *πόρος*.

MILLEPORA (part.), Jameson.

TUBULIPORA (part.), Fleming : Johnston : &c.

DOMOPORA, D'Orbigny (1847), *Prodrome de Paléontologie* : Busk : Peach.

CORONOPORA, Gray (1848) : Smitt.

DEFRANCIA (part.), Reuss : Hagenow : Sars : Manzoni : &c.

CERiopORA, Goldfuss.

STELLIPORA (part.), Hagenow (*vide* D'Orbigny).

CORYMBOPORA, Smitt (not Michelin).

SEMIMULTICAVERA (part.), D'Orbigny.

GENERIC CHARACTER.—ZOARIUM *massive, cylindrical or mammiform, simple or lobed, formed of a number of sub-colonies superimposed one upon the other; the whole surface porous. ZOECIA disposed in radiating lines, consisting of one or more series, on the free extremity of the stem or lobes.*

DOMOPORA STELLATA, Goldfuss.

Plate LXIII, figs. 10–14.

TUBULIPORA TRUNCATA, *Flem.* B. A. 529 : *Johnst.* (part.), B. Z. ed. 2, 271 (*not* pl. xxxiii. figs. 8–10).

CORONOPORA TRUNCATA, *Gray*, B.M. Rad. 140 : *Sars*, *Reise Lof. og Finn.* 145 : *Busk*, *Rep. Br. Assoc.* 1859, *Trans. Sect.* 146 : *Smitt*, loc. cit. 408 & 491.

DEFRANCIA TRUNCATA, *Sars*, *Norsk. Polyz., Vid. Selsk. Förh.* 1862, 20 : *Norman*, *Brit. Assoc. Rep.* 1868, *Shetl. Dredg. Rep.* 310.

STELLIPORA STELLATA, *Hagenow*, *Bryoz. Maast. Kreidebildung*, 44 (*teste* Goldfuss).

CERiopORA STELLATA, *Goldfuss*, *Petrefact.* i. 39, pl. xxx. fig. 12.

DEFRANCIA STELLATA, *Reuss*, *Foss. Pol. Wien. Tertiär.* 37, pl. vi. fig. 2 : *Manzoni*, *Bryoz. foss. Mioc. d'Austr. ed Ungher.* pt. iii. 16, pl. xvi. fig. 3 : *Busk*, *Ann. N. H. ser.* 2, xviii. 36, pl. i. fig. 9.

? CORYMBOPORA FUNGIFORMIS, *Smitt*, loc. cit. 407 & 490, pl. xi. figs. 13, 14.

DOMOPORA TRUNCATA, *Busk*, B.M. Cat. iii. 35, pl. xxxi. figs. 1, 2.

DOMOPORA STELLATA, *Peach*, *Journ. Linn. Soc., Zool.* xiii. 484.

(*Not Millepora truncata*, Jameson.)

Zoarium erect, rising from an irregular, incrusting porous base, more or less stalked and cylindrical below, simple or lobed, sometimes distinctly branched, sometimes merely proliferous, and bearing clusters of expanded lobes, on which the celliferous rays are disposed. *Zoæcia* bi- or triserial, vertical, minutely punctate, united so as to form much elevated, radiating or lamellate rows on the extremity of the lobe, which presents a stellate appearance; general surface of the zoarium completely covered with somewhat hexagonal pores. *Oæcia* elongate irregular inflations, formed of a minutely granulated calcareous crust, and situated on or near the border of the stellate capitula, the "orifice short and round, and variously placed" (*Smitt*).

Polypide with 8 long tentacles.

THIS very beautiful and characteristic species has long been well known, and has been accurately described by various authors, by none more fully or graphically than by the elder Sars. Much confusion, however, has been introduced into the synonymy by Johnston's mistaken identification of it with the *Tubulipora truncata* of Jameson and Forbes. It was first described by Fleming under the latter (specific) name, which Jameson, however, had previously applied to a totally different form. Johnston, assuming the identity of the species which these authors had in view (he had probably only specimens of Jameson's species before him), ranked the *Millepora truncata* of the latter and the *Tubulipora truncata* of Fleming as synonymous; and the error has pervaded our systematic literature to this day. The species which Jameson originally discovered, and which Edward Forbes supplied to Dr. Johnston, has been lost sight of; Fleming's species, in usurping its name, has supplanted it.

We are indebted to Mr. Peach's sagacity for its restoration. He recognized the existence of two distinct forms,

both included under Johnston's *T. truncata*, and was able to identify the one which Forbes had dredged in Shetland with specimens of his own from the same locality. It proves to be, as might have been expected from Johnston's remarks upon it* and figure, very different from *Domopora stellata*, and will now enjoy, we may hope, undisputed possession of the name originally conferred upon it.

In *D. stellata* the zoarium adheres by an expanded porous base, from which an erect subcylindrical stem rises, which is sometimes short and stout, and dilates almost at once into a capitulum, on the upper part of which the zoœcia are disposed in prominent lamelliform rays. In certain stages a second capitulum is developed by budding from the base or side of the first, and the zoarium becomes bilobate. By repeated gemmation it takes on a clustered form, many short processes, each bearing a number of celliferous capitula, being united in one composite structure (Plate LXIII. fig. 10). In proliferous specimens of this kind, the "stars" or cell-bearing capitula may number from 7 to 13 or even 16 (*Sars*). In Mr. Peach's finest specimen there are 15. The stars are much crowded together on the separate lobes, one lobe bearing as many as seven. The lamellæ are subtriangular in form and stand out very prominently. The boundaries of the cells, which are ranged in two or three series, are visible on the sides, and give them a lineated appearance.

The habit in the proliferous form, which I have just described, is dwarf and stunted; the lobes supporting the capitula are extremely short and can hardly be called branches. But the species sometimes assumes a very different form: the stem is much elongated by successive

* 'British Zoophytes,' p. 271 (after the paragraph from Fleming) and p. 272.

growths, superimposed one upon another, and at length divides dichotomously into distinct cylindrical branches, which, again, may subdivide into a number of short terminal lobes (Plate LXIII. fig. 11). The successive increments to the stem and branches are clearly indicated by transverse grooves on the surface. Not unfrequently the capitula are rounded and slightly furrowed on the upper part, but show no traces of the celliferous lamellæ; this is probably an immature condition, and it closely resembles that which is permanent in *D. truncata*.

The *Corymbopora fungiformis* of Smitt is probably founded on a simple specimen of the elongate form in an imperfectly developed state (Plate LXIII. fig. 13).

I am indebted to Mr. Peach for the opportunity of examining a very fine series of specimens, which fully illustrate the various stages of growth and diversities of habit.

HABITAT. On stones, shells, *Serpulæ*, &c., from deep water.

LOCALITIES. Zetland, deep water (Fleming, Peach): *ibid.*, not uncommon on the Outer Haaf, in 70–170 fathoms (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Norway (Rasch): *ibid.*, from Bergen to Bejan, 40–60 fathoms (Sars).

RANGE IN TIME. “*In stratis arenoso-margaceis Westphaliæ*” (Goldfuss): Austro-Hungarian Miocene (Manzoni): Vienna basin (Reuss).

DOMOPORA TRUNCATA, Jameson.

Plate LXIII. figs. 5-9.

MILLEPORA TRUNCATA, *Jameson*, Wern. Mem. i. 560.TUBULIPORA TRUNCATA, *Johnst.* (part.), B. Z. ed. 2, 271, pl. xxxiii. figs. 8-10 (not good).DOMOPORA TRUNCATA, *Peach*, Journ. Linn. Soc., Zool. xiii. 483. (Not *Tubulipora truncata*, Fleming, nor *Defrancia truncata*, Busk, Annals, ser. 2, xviii.)

Zoarium mammiform, with an adherent, expanded, circular base, white; surface porous, sometimes simple, sometimes proliferous, and consisting of a cluster of the mamillated disks, the top rounded and furrowed. *Zoæcia* disposed in very slightly elevated multiserial rows, varying in number, separated by very shallow grooves, which originate at the base of the rounded top and radiate towards the summit.

Height not exceeding $\frac{1}{4}$ inch, usually less.

THIS species varies much in different stages and conditions of growth. In its young state it consists of a more or less circular adherent disk, with a cellular border, sloping a little outwards, very slightly elevated in the centre, towards which a number of indistinct rays, originating on the inner edge of the border, converge. The whole surface is porous; but the zoæcia are aggregated on the radiating rows. In this stage there is the merest rudiment of the central, somewhat dome-shaped rising which is characteristic of the adult, and the zoarium very closely resembles a *Lichenopora*. The mamillary elevation seems to be formed by successive growths, superimposed one upon another. Frequently the expanded base bears a group of several mamillæ, which are sometimes united in pairs; in one case six are joined together in one composite colony, each of the buds developed on the discoid

crust having its own slightly expanded base. Occasionally fresh disks are produced towards the edge of the original crust, which increase the area of the colony. Gem-mation takes place, to a limited extent, from the surface of the mamillary risings, as well as from the crust (Plate LXIII. fig. 5); but there is never any distinct branching as in the preceding species. The rows of cells are chiefly confined to the rounded top of the mamillæ, radiating from the base to the summit; but in some cases they extend to the very edge of the border of the disk. They are very slightly raised, and separated by mere superficial furrows, and never form erect and prominent lamellæ, such as we find in *D. stellata*. Of the largest specimen which I have seen, the longer diameter is nearly $\frac{3}{4}$ inch, and the shorter about $\frac{1}{2}$ inch. This form connects the present group very closely with the *Lichenopora**.

The foregoing account is based on a most interesting series of specimens, for which I am indebted to the kindness of Mr. Peach.

HABITAT. On large stones from deep water.

LOCALITIES. Shetland (Jameson and Prof. E. Forbes) : *ibid.*, brought up by the fishermen's lines from about 80–100 fathoms in the Out Haaf (C. W. P.).

Doubtful Species.

TUBULIPORA HYALINA, Couch.

TUBULIPORA HYALINA, Couch, Corn. Faun. iii. 108: *Johnst. B. Z.* ed. 2, 276.

Zoarium adnate, semitransparent, membrano-calcareous.

Zoecia distinct, tubular, erect, arranged in one or two circular rows round a plain centre; orifice unarmed and frosted.

* *D. truncata* resembles in many respects the *Semimulticavea* (*Domopora*) *tuberculata* of D'Orbigny, which is evidently a kindred form (Pal. Franç. terr. crét. p. 980, pl. 648. figs. 1–4).

Colonies forming small patches of about the diameter of a pea.

HABITAT. On *Fucus palmatus*.

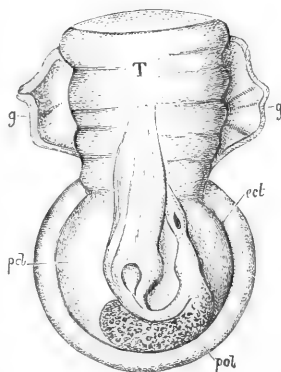
LOCALITY. Polperro, rare (Couch).

Possibly founded on young specimens of some species of *Lichenopora*.

NOTE ON THE ORIGIN OF THE CYCLOSTOME COLONY.

ACCORDING to Barrois*, the larva of *Tubulipora*, soon after fixation, appears as a discoid body (woodcut, fig. 26, *pd*), which is inclosed by an obscurely cellular endocyst, around which a calcareous ectocyst is developed, forming an opaque ring round the whole structure (fig. 26, *ect*). The centre of the discoid cell is occupied by a pyriform body; and between this and the inner wall (endocyst) lies a soft and transparent mass of fatty globules. The central body is gradually moulded into a polypide (fig. 26, *pol*): from the endocyst a round swelling originates over the tentacular region of the polypide, which is developed into a calcareous tube (fig. 26, *T*). The tentacles are soon partially included in this tube, which ultimately becomes the true cell and the permanent home of the polypide. The original disk is converted into a mere organ of attachment, and is separated by a diaphragm from the tubular cell. In this condition it commonly occurs attached to the adult *Cyclostomatous* colony.

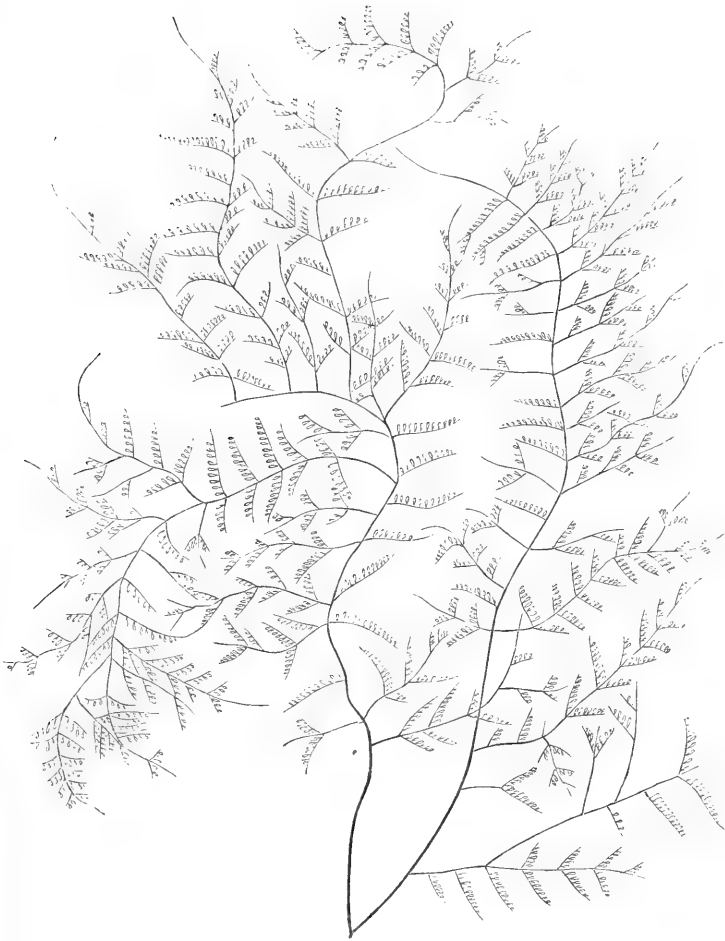
Fig. 26.



* 'Rech. sur l'embryologie des Bryozoaires,' pp. 70, 71.

“ Dans ces animaux inférieurs, si beaux de simplicité et si riches de formes, on peut faire l'anatomie des organes sans attendre la mort ; à travers l'enveloppe transparente on voit fonctionner tous les appareils ; la nourriture se transforme sous les yeux de l'observateur, les pertes se réparent en sa présence ; on voit les embryons se former pièce par pièce ; * * * * * c'est un atelier en pleine activité et dans lequel on peut étudier et les allures et les gestes de chaque ouvrier ou de chaque organe.”—
VAN BENEDEN.

Fig. 27.

*Mimosella gracilis.*Suborder III.—**CTENOSTOMATA***, Busk.

CTENOSTOMATA, Busk: Alder: Gosse: Smitt: Heller: Carus: Joliet: &c.
 HALCYONELLEA and VESICULARINA, Johnston.

* The diagnosis of the suborders will be found in the portion of the Introduction devoted to Classification.

Group *a.* *HALCYONELLEA*, Ehrenberg.*ALCYONIDULÆ*, Johnston, Brit. Zooph. ed. 1.*POLYZOA CARNOSA*, Gray.

ZOARIUM *fleshy or membranous. ZOÆCIA* *developed by budding from other zoæcia, and not from the internodes of a stolon.*

Family I.—*Alcyonidiidæ*.*ALCYONIDULÆ*, Couch.*HALCYONELLEÆ*, Smitt.

ZOÆCIA *more or less closely united, immersed in an expanded and adherent gelatinous crust, or forming an erect cylindrical or compressed zoarium; orifice closed by the mere invagination of the tentacular sheath; not protected by external labia.*

Genus *ALCYONIDIUM*, *Lamouroux*.

Der. From *Alcyonium*, a genus of *Actinozoa*, to which the present was supposed to bear some resemblance.

ALCYONIDIUM, Lamx. Exposit. Méthod. (1821): Johnston: Couch: &c.*ALCYONIUM* (part.), Linnæus: Pallas: Müller: Fleming: &c.*HALODACTYLUS*, Farre (1837): Van Beneden.*CYCLOUM* (sp.), Hassall.*SARCOCHITUM* (sp.), Hassall.

GENERIC CHARACTER.—*ZOÆCIA* *immersed or subimmersed; the orifice simple, papillæform. ZOARIUM* *gelatinous or argillaceous, either crustaceous or erect.*

a. *Zoarium gelatinous.*

ALCYONIDIUM GELATINOSUM, Linnæus.

Plate LXIX. figs. 1-3.

SEA RAGGED STAFF, *Ellis*, Corall. 87, pl. xxxii. figs. d, D.ALCYONIUM GELATINOSUM, *Linn.* Syst. ed. 12, 1295: *Pallas*, Elench. 353: *Müller*, Zool. Dan. iv. 30, pl. cxlxii.: *Ell. & Soland.* Zooph. 176: *Lamx.* Pol. cor. flex. 350: *Blainv.* Actinol. 525, pl. xcii. fig. 1: *Dalyell*: &c.ULVA DIAPHANA, *Sowerby*, Engl. Bot. pl. cclxiii.: *Lamk. & De Candolle*, Flore Franç. ii. 6.EPIPETRUM GELATINOSUM, *Oken*, Lehrb. Naturgesch. Zool. Abth. 2, 80.ALCYONIDIUM DIAPHANUM, *Lamx.* Gen. Thalass. 71, pl. vii. fig. 4.HALODACTYLUS DIAPHANUS, *Farre*, Phil. Trans. 1837, 405, pls. xxv. & xxvi.: *Van Ben.* Rech. 60, pl. viii. fig. 12 (Mém. Bruxelles, xviii. 1845).ALCYONIDIUM GELATINOSUM, *Johnst.* B. Z. ed. 2, 358, pl. lxxviii. figs. 1-3: *Gray*: *Landsb.*: *Gosse*: *Alder*: *Hincks*: *Smitt*, &c.

Zoarium erect, gelatinous, subcylindrical or sometimes slightly flattened, yellowish or greenish yellow, simple or variously lobed and branched, assuming the most diverse shapes. *Zoæcia* closely packed together, their orifices marked by low, blunt papillæ which are crowded together over the entire surface.

Polypide with 15-17 extremely slender and flexible tentacles.

Height usually several inches; sometimes as much as two or three feet.

HABITAT. On stones, shells, rocks near low-water mark, crabs &c. from tide-marks to deep water.

LOCALITIES. Common and widely distributed. South Devon; Ilfracombe; Isle of Man; Llandudno, tide-marks; Filey; Oban (T. H.); Cornwall (Couch); St. Andrews (Dr. M'Intosh); Northumberland (Alder); Isle of Sheppey, abundant (Farre); Bass Rock, 24 fathoms; S.E. off

Yarmouth, 16 fathoms (Kirchenpauer): Shetland, 5–8 miles east of Balta, 40–50 fathoms, sandy bottom; 6 miles north of Whalsey Lighthouse, 40 fathoms (A. M. N.): of occasional occurrence on the north-east coast of Ireland; Belfast Bay (W. T.): Youghal (Miss Ball): &c.

GEOGRAPHICAL DISTRIBUTION. Ostend (Van Ben.): Bahusia, at great depths and in 20 fathoms (Lovén, Smitt): Spitzbergen (Swed. Exped.): Kattegat; North America (Kirchenpauer): Greenland (Lütken): White Sea (Mereschkowsky): Nova Zembla, Matotschkin-scharr, 15 fathoms and 40–50 fathoms: Kara Sea (Stuxberg and Théel): Natal (W. Oates).

It is difficult to frame a description that can give any idea of the forms assumed by this protean species. In one of its most characteristic states it is cylindrical above the contracted base, with an obtuse extremity, and often of very great length. But frequently this finger-like growth is covered on all sides, and from top to bottom, with short lobate or nodulous processes, giving it a singularly rough and rugged appearance. Nothing can be better than the quaint description of it in this condition which we have from Johnson, the editor of 'Gerarde's Herbal,' who was the first to characterize the species:—"It is of a dark yellowish colour," he says, "and buncheth forth on everie side with many unequal tuberosities or knots." It is sometimes more decidedly branched in an irregular straggling fashion. In some states it is compressed or flattened; but the subcylindrical habit is more characteristic.

The polypides are present in enormous numbers, closely packed together in the outer zone of the semipellucid cylindrical stem, the centre of it being occupied by a cellular tissue and fluid. The surface of the zoarium is

generally described as smooth ; but, though destitute of the prominent imperforate papillæ which distinguish the following species, the orifices of the zoœcia are marked by very small (but distinct) blunt tubercles. Ellis correctly described it as "full of minute papillæ which send forth polypes."

Dr. Farre, from whom we have an admirable account of its structure, has remarked that the arms are sometimes (as in other cases) much longer on one side than the other, so as to give an obliquely truncate appearance to the tentacular bell. The opercular setæ are short and very stout ; Smitt gives the number at 12 to 13. The ciliated intertentacular organ, which occurs on *Membranipora pilosa* and other species, is sometimes met with on *A. gelatinosum*.

ALCYONIDIUM HIRSUTUM, Fleming.

Plate LXX. figs. 4-7.

ALCYONIUM HIRSUTUM, *Flem.* B. A. 517.

ALCYONIDIUM HIRSUTUM, *Johnston*, B. Z. ed. 2, 360, pl. lxix. figs. 1. 2 : *Couch*, Corn. Faun. iii. 133 : *Van Ben.* (Halodactyle velu), *Rech.*, Mém. Bruxelles, xviii. 37 (sep.), pl. v. figs. 3-8 : *Alder*, Northumb. Cat. 63 (sep.) : *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 470 (56, sep.) : *Gosse*, Mar. Zool. pt. 2, 19, fig. 30.

? ALCYONIUM PALMATUM, *Dalyell*, Rem. Anim. ii. 43, pls. xv., xvii.

CYCLOUM PAPILLOSUM, *Hassall*, Ann. N. H. vii. 483 : *Johnston*, B. Z. ed. 2, 364, pl. lxx.

ALCYONIDIUM PAPILLOSUM, *Smitt*, loc. cit. 499 & 516, pl. xii. figs. 20, 21. (Not *A. hirsutum*, *Smitt*.)

Zoarium of rather firmer consistency than the last, in-crusting or erect, compressed, expanded, palmate, much and variously divided, of a yellowish-brown colour ; the surface thickly covered with tall, imperforate, conical papillæ, amidst which the slightly prominent zoœcial orifices are placed.

Polypide with 17–18 long and slender tentacles, which are often spirally coiled and much twisted.

Height 5 or 6 inches.

HABITAT. On Algæ between tide-marks and in shallow water.

LOCALITIES. South Devon; Ilfracombe, on *Corallina*; Watchet, Bristol Channel; Isle of Man; Filey; Landudno; Menai Straits; Oban (T. H.): Cullercoats, of humble size; North Northumberland, 5 or 6 inches high and about as much broad, largest beyond low water (Alder): St. Andrews (Dr. M'Intosh): Shetland, Balta Sound, and Out-Skerries, tide-marks (A. M. N.): entrance to the Firth of Forth, 30 fathoms (Kirchenpauer): Hastings (Miss Jelly); Northern shores of Ireland, not uncommon, especially on *Delesseria alata*; Connemara (W. T.): Dublin Bay; Youghal (Miss Ball): Glendore (Allman).

GEOGRAPHICAL DISTRIBUTION. Roscoff (Joliet): Kattegat (Kirchenpauer): Bahusia, chiefly on *Fucus serratus*; Spitzbergen, 12 fathoms, on *Fucus* (Smitt): Finmark (Goës and Malmgren): Greenland (Lütken).

This species occurs in two very distinct forms—as a rather thick gelatinous crust, overspreading various kinds of Algæ, in which state it is in all probability the *Cycloum papillosum* of Hassall; and as an erect, palmate growth, which often attains a very considerable size. On the South-Devon coast it grows luxuriantly, forming large palmate expansions, several inches in width, variously lobed, and of remarkable beauty. These are given off from a spreading base.

Dr. Johnston mistook the papillæ for the zoœcia; but the orifices of the latter form low, irregularly-shaped risings, slightly depressed in the centre, and are distri-

buted over the surface amongst the larger imperforate prominences. Smitt, misled by his diagnosis, has separated his *A. hirsutum* from the *Cycloum* of Hassall; the former he identifies with the *A. mamillatum* of Alder*. Of the identity, however, of Hassall's species with the present there can be little doubt. The arrangement of the ova circularly in clusters scattered over the zoarium, to which he attached so much importance as to make it a generic distinction, is common amongst the *Alcyonidia*. I have described it as it occurs in *A. mytili*, in which the character of the reproductive cells and disposition of the ova agree perfectly with Hassall's account.

This author states that on more than one occasion he has seen specimens of his *Cycloum* "enveloped in a firm coating of ice;" when it was dissolved the polypides expanded their tentacles and displayed their usual activity. Such power of enduring cold we might expect in a littoral species whose principal home is in northern latitudes. I have seen the larvæ of this species liberated in great numbers towards the close of January, in very severe weather.

ALCYONIDIUM MAMILLATUM, Alder.

Plate LXIX. figs. 7, 8.

ALCYONIDIUM MAMILLATUM, Alder, North. Cat. Trans. Tynes. N. F. C. 64 (sep.), pl. v. figs. 3, 4: Smitt (= *A. hirsutum*, Smitt), Nova Zembla Bryoz., Öfv. K. Vet.-Akad. Förh. 1878, no. 2, 11.

ALCYONIDIUM HIRSUTUM, 1. Zoœciis hexagonis, a. formæ incrustantes, ββ. forma membranacea, Smitt, loc. cit. 497 & 511, pl. xii. figs. 5, 6.

Zoarium a rather thick crust, semitransparent, brownish.

Zoœcia ovate, the anterior extremities produced into

* Polyzoa of Nova Zembla, Öfv. K. Vet.-Ak. Förh. 1878, no. 3, 11.

tall, stout, subconical papillæ, wrinkled transversely, from which the polypides issue, and which render the surface hirsute.

Polypide with 16–18 tentacles.

HABITAT. On old shells, Ascidians, stems of zoophytes, from shallow to deep water.

LOCALITIES. Northumberland, deep water (Alder): Filey (T. H.).

GEOGRAPHICAL DISTRIBUTION. Bahusia, 10–12 fathoms; Spitzbergen, 5–30 fathoms (Smitt): Nova Zembla, Beluscha Bay, 60–70 fathoms; Kara sea (Stuxberg & Théel).

This very marked species is at once recognizable by its roughened surface. The zoarium seems to be always adherent; the cells are prolonged above; and the produced portion, supporting the orifice, turns upward and forms an elongate, somewhat conical process, which is strongly wrinkled. The roughness of the surface is quite apparent to the naked eye. The crust is thick and somewhat coriaceous.

ALCYONIDIUM LINEARE, Hincks.

ALCYONIDIUM LINEARE, *Hincks*, MS. and Ann. N. H. for September, 1877, 217: *Alder*, North. Cat. loc. cit. 21 (sep.).

ALCYONIDIUM HIRSUTUM, forma HIPPOTHOEIDES, *Smitt*, loc. cit. 497.

Zoæcia oval, with prominent tubular orifices, immersed in a gelatinous crust, disposed in linear series, which generally branch from a central mass.

HABITAT. On shells from deep water.

LOCALITIES. Dogger bank, on mussels (T. H.): Culler-

coats, deep water, not unfrequent, "running over shells in lines" (Alder).

This species is included by Mr. Alder under the above name in his 'Catalogue.' I had previously corresponded with him about it, and had so named it in my letters, but had published no description of it. My specimens of it have unfortunately perished; and I can add but little from my notes or from memory to the brief account which has been given of it.

The tubular aperture is very prominent and directed upwards, projecting at the extremity of the cells, instead of standing erect as in other species. To the best of my recollection, the orifices are turned slightly outwards; and I find, from a note made at the time of its first occurrence, that it resembles a *Stomatopora* in habit.

ALCYONIDIUM DISJUNCTUM, Hincks.

Plate LXX. fig. 1.

ALCYONIDIUM DISJUNCTUM, *Hincks*, Ann. N. H. ser. 4, xx. 217.

Zoarium incrusting. *Zoæcia* elongate-ovate, disposed in linear series, which bifurcate at intervals and occasionally anastomose; the lines of cells bordered by a gelatinous crust; orifice small, not raised, placed near the anterior extremity; cells often massed together.

HABITAT. On pieces of broken pottery.

LOCALITY. Unknown; probably Northumberland. My specimens were received from Mr. Alder.

The cells are elongate and sometimes subtruncate at the two extremities, and are linked together in single

series ; on each side runs a margin of the gelatinous (?) crust. The series bifurcate frequently, two lines originating from the summit of a cell. At the bifurcation the crust forms a web-like expansion between the two series. Every here and there collections of cells occur, from which the single series are given off.

I have only had the opportunity of examining dried specimens of this form ; and there is therefore a possibility that in some points the characters may not be adequately represented.

ALCYONIDIUM MYTILI, Dalyell.

Plate LXX. figs. 2, 3.

ALCYONIDIUM MYTILI, *Daly.* Rem. An. ii. 36, pl. xi. : *Smitt*, loc. cit. 496 & 507, pl. xii. figs. 1, 2.

ALCYONIDIUM HEXAGONUM, *Hincks*, Quart. Journ. Micr. Sc. v. 176 ; Ann. N. H. ser. 3, ix. 470 : *Alder*, North. Cat., Trans. Tynes. F. C. 1857, 65 (sep.).

ALCYONIDIUM PARASITICUM, *Smitt*, Öfv. Vet.-Ak. Förh. 1865, 27, pl. v. figs. 8-19.

? SARCOCHITUM POLYUUM, *Gosse*, Mar. Zool.

Zoarium incrusting, fleshy, dingy white or yellowish, sometimes of a darker colour ; thickly covered, when the polypides are retracted, with very small obtuse prominences. *Zoæcia* hexagonal, the septa showing distinctly on the surface.

Ovarian cells scattered over the zoarium, the ova opaque-white, disposed circularly within them.

Polypide with about 15-18 tentacles.

HABITAT. On shells, stones, and *Fucus* from tide-marks to deep water.

LOCALITIES. Probably very common and generally distributed, though few localities have been recorded. Scot-

land (Dalyell): South Devon, Salcombe Bay, Torbay, incrusting shells of *Trochus*, &c.; Mount's Bay, Cornwall; Ilfracombe; Llandudno; Isle of Man, common; Menai Straits; Herm, on *Trochus* (T. H.): Northumberland, common (Alder).

GEOGRAPHICAL DISTRIBUTION. Bahusia, on Algæ, 5–20 fathoms (Smitt): Baltic Sea, eastern basin, very abundant (K. Möbius).

The cells in this species are normally hexagonal; but they are subject to many irregularities, and in older colonies, where they are closely packed together, they vary greatly in figure. The septa are usually distinctly visible on the surface. The crust is sometimes very thin; in other states it is much thicker, loses much of its transparency, and becomes charged (according to Smitt) with argillaceous particles. There are also varieties in the colour. The species, however, is readily recognizable by its comparatively smooth surface, mapped out into distinct areas by the zoœcial septa.

The ovaries are distributed irregularly, and often in great numbers, over the zoarium, and occur as somewhat circular papillæ, within which the opaque-white ova are visible, ranged so as to form a ring. The ovarian chamber is merely a zoœcium destitute of polypide, and set apart for the discharge of reproductive functions.

The mature embryos may be seen moving about freely within the cavity; when about to escape, a tubular orifice is gradually pushed forth at a point near the top of the cell, marked by a slight depression, through which they successively work their way by means of their cilia. I have seen seven pass from a single chamber in the course of a few seconds; and very interesting it was to watch them struggling through the narrow passage and launching

themselves into their new sphere of being. As the sunlight fell upon the cilia, they were tinted with a most lovely violet colour. As soon as they have effected their escape, the larvæ begin to move with great activity through the water*.

ALCYONIDIUM ALBIDUM, Alder.

Plate LXX. figs. 8-12.

ALCYONIDIUM ALBIDUM, Alder, North. & Durh. Cat., Trans. Tynes. Nat. F. C. 64 (sep.), pl. v. figs. 5, 6.

ALCYONIDIUM HIRsutUM, 2. γ, forma *incrustans*, Smitt, loc. cit. 497 and 511.

Zoarium incrusting, semitransparent, yellowish white.

Zoæcia distinct, ventricose, not closely united, flask-shaped, recumbent below, suberect towards the oral extremity.

Polypide with 18 tentacles.

HABITAT. On Algæ, zoophyte-stems &c., shallow to deep water.

LOCALITIES. Northumberland, on *Hydrallmania falcata* from the deep-water fishing-boats (Alder): Ilfracombe, not uncommon (Leipner): Shetland (T. II.):

GEOGRAPHICAL DISTRIBUTION. Spitzbergen, 30 fathoms (Malmgren, *teste* Smitt).

The most striking feature of this species is the more or less disconnected condition of the cells. In the younger portions of the colony they are often completely separated, and present the appearance of distinct flask-shaped bodies united by a common crust (Plate LXX. fig. 8). In this state they are readily detached from

* See a paper by the author in the Quart. Journ. Micr. Sc. vol. v. p. 176.

the mass ; figure 10 is taken from two zoëcia which had fallen from a specimen preserved in fluid. In the inner and older parts of the crust they lie more closely together, but are still very distinct and retain much the same form. The lower part of the cell is ovate and recumbent ; the anterior extremity is bent upwards and suberect, and forms the neck of the flask-shaped figure. As Alder has remarked, this species in certain states “ looks somewhat like a cluster of separate animals.”

ALCYONIDIUM POLYOUM, Hassall.

Plate LXIX. fig. 9.

SARCOCHITUM POLYOUM, *Hassall*, Ann. N. H. vii. 484: *Johnst. B. Z.* ed. 2, 365, pl. lxxi.

Zoarium forming a thin fleshy crust, covered with numerous large papillæ of irregular form and unequal size, from which the polypides issue. *Ova* scattered singly through the zoarium.

Polypide with 20 tentacles.

HABITAT. On *Fucus serratus* &c., and on shells and stones.

LOCALITIES. Dublin Bay (*Hassall*): Northumberland, on the underside of stones, tide-pools (*Alder*) *.

GEOGRAPHICAL DISTRIBUTION. Roscoff, especially on *Rhodhymenia palmata* and *Fucus serratus*, very fine (*Joliet*).

A. polyoum is chiefly distinguished from *A. mytili* by

* Mr. Alder was rather doubtful as to his identification of the Northumberland form with the present species. *A. polyoum* is included in my Devon Catalogue; but I am now inclined to think that the specimens which I referred to it really belonged to *A. mytili*.

having no septa visible on the surface, and by its large papillæ, marking the entrance of the cells. The ova also appear to be distributed singly throughout the zoarium, instead of being produced in clusters. Joliet* states that it occurs under two very different forms: in its young state it consists of a very delicate transparent crust; but with age it increases in thickness, and forms at last a fleshy mass which covers the *Fuci* so as completely to distort them, and even throws out occasional lobes. In this condition it has a spongy appearance, and is of a dull grey colour. In the months of May and June, he adds, the ova are developed in immense numbers, and appear as white, or occasionally rose-coloured, points scattered over the surface of the colony.

The species requires further investigation.

b. *Zoarium argillaceous.*

ALCYONIDIUM PARASITICUM, Fleming.

Plate LXIX. figs. 4-6.

ALCYONIUM PARASITICUM, *Flem.* B. A. 518: *Blainv.* Actinol. 525.

ALCYONIDIUM PARASITICUM, *Johnst.* B. Z. ed. 2, 362, pl. lxviii. figs. 4, 5: *Hassall*, Ann. N. H. vii. 370: *Reid*, Ann. N. H. xvi. 393, pl. xii. fig. 11: *Van Ben.* (*Halodactylus*) *Rech.* (Mém. Bruxelles, xviii.), 62, pl. viii. figs. 9-12: *Dalyell*, Rem. An. ii. 33, pl. x.: *Smitt*, loc. cit. 498 and 514, pl. xii. figs. 14-19, &c.

Zoarium incrusting, argillaceous. *Zoæcia* very small, with minute papillæ disposed round an oval or circular area, which is covered by a smooth hyaline membrane.

Polypide with 15-16 tentacles.

* 'Bryozoaires des côtes de France,' 1877, p. 100.

HABITAT. On the stems and branches of Sertularian Hydroids (especially *Hydrallmania falcata*), which it invests with an earthy coating.

LOCALITIES. St. Andrews, abundant (Reid & M'Intosh): Northumberland, common (Alder): Filey; Menai Straits; South Devon, not common (T. H.): Cornwall (Couch): Ireland, north and east shores (W. T.): Dublin Bay, common (Hassall).

GEOGRAPHICAL DISTRIBUTION. Bahusia, not rare (Lovén).

Descriptions of this species have commonly been founded on dried specimens, and have therefore failed to represent its true character. In this condition it appears as an earthy incrustation, with a porous surface (Plate LXIX. fig. 5). Smitt has given us an account of it, founded on Lovén's detailed observations, which leaves little to be desired*.

The younger marginal cells are somewhat elongate in shape, with distinct septa and a finely granulated surface. In the older portions of the colony they are shorter, with a circle of minute papillæ, a little within the margin, forming an opaque border, in the midst of which there is a rounded area, covered by a hyaline membrane. In the oldest cells the septa are no longer visible, the papillæ are irregularly placed, or form several rows round the central area, which still retains the transparent membranous covering. In all cases the zoœcia are exceedingly small.

* It should be noted that Hassall's brief description of this species (the true nature of which he seems to have been the first to determine), published in 1841, agrees substantially with Lovén's.

Doubtful Species.

ALCYONIDIUM RADIATUM, Alder, MS.

IN his Report on Shetland Polyzoa, Norman mentions a species of *Alcyonidium* which he had found between tide-marks in the Out Skerries, and to which Mr. Alder had given the above (manuscript) name. No description of it has been published.

Family II.—Flustrellidæ.

HALCYONELLEÆ (part.), Smitt.

ZOÆCIA *immersed in a gelatinous crust ; orifice bilabiate.*

LARVÆ *furnished with a bivalve shell.*

Genus FLUSTRELLA, Gray.

Der. Dim. of *Flustra*, the sea-mat.

FLUSTRELLA, Gray, B.M. Cat. Radiata: Redfern: Alder: &c.

FLUSTRA (part.), Fleming: Blainville: Johnston: Couch: Hincks: &c.

ALCYONIDIUM (part.), Smitt.

(Not FLUSTRELLA of D'Orbigny.)

GENERIC CHARACTER.—ZOÆCIA *immersed, the orifice bilabiate, with a movable lip, which acts as an operculum.*
ZOARIUM *a gelatinous crust.*

THIS genus is distinguished from *Alcyonidium*, with which it agrees in most points, by an important difference in the structure of the orifice. It is furnished with a

kind of external operculum, which, though not so highly organized as that of the *Cheilostomata*, bears some analogy to it, and is very different from the ordinary Ctenostomatous structure. The orifice in *Flustrella*, which is placed at the very top of the cell, resembles exactly the opening of a common clasp-purse. It is bounded above and below by narrow horny ribs, which correspond with the metal clasps of the purse, and which are connected at the sides much in the same way as the latter, and so as to allow of their opening and closing. When the polypide is about to issue from its cell the mouth opens, just as the purse does, by the separation of the two ribs (or lips), which come together again on its retreat. The upper lip seems to be fixed, and is very slightly arched; the movable portion appears to be the lower lip, which, though not furnished with a hinge, like the operculum of the *Cheilostomata*, bends outwards to allow of the passage of the polypide. In this respect, of course, the analogy with the purse fails. When the orifice is fully open, it is somewhat quadrangular in form. This arrangement is replaced in *Alecyonidium* by the simple inversion of the oral apparatus, giving rise, during retraction, to the formation of a papillary eminence, puckered in the centre, on the surface of the zoarium. As the polypide of *Flustrella* issues, a stout cylinder is first protruded, which often remains exerted in spirit specimens.

In another point the genus exhibits some divergence from the rest of the present suborder. The setose operculum is much less conspicuous than it usually is, and, indeed, is often difficult to detect; but it exists, and is composed of numerous small and slender bristles. The embryology of the genus presents some interesting points. It has been recently investigated by Barrois and Joliet, who have demonstrated the somewhat complex organization of the

larva (*Cyphonautes*), which is furnished with two transparent valves, resembling in shape those of a *Cypris*, within which the soft portions of the body are lodged. As in other cases, this highly organized larva, on becoming fixed, is reduced, so far as the soft portions of its structure are concerned, to an amorphous mass of protoplasm, from which the primary polypide is developed*.

The *Alcyonidium corniculatum* of Smitt, from Spitzbergen, is a second species of the present genus.

FLUSTRELLA HISPIDA, Fabricius.

Plate LXXII. figs. 1-5.

- FLUSTRA HISPIDA, *Fabricius*, Faun. Grœnl. 438: *Flem. B. A.* 537: *Johnston*, Trans. Newc. Soc. ii. 266, pl. ix. fig. 7: *Blainv.* Actinol. 450: *Hincks*, Ann. N. H. ser. 2, viii. 357, pl. xiv. figs. 1-4.
- ALCYONIDIUM HISPIDUM, *Johnst. B. Z.* ed. 2, 363, pl. lxvi. fig. 5: *Smitt*, loc. cit. 499 and 517, pl. xii. figs. 22-27.
- FLUSTRA SPONGIOSA, *Templeton*, Loud. Mag. N. H. ix. 469.
- MEMBRANIPORA SPONGIOSA, *Johnst. B. Z.* ed. 1, 282.
- FLUSTRA CARNOSA, *Johnst. B. Z.* ed. 1, 288, pl. xxxvii. fig. 5: *Couch*, Corn. Faun. iii. 125: *Hassall*, Ann. N. H. vii. 369.
- CYCLOUM HISPIDUM, *W. Thompson*, Nat. Hist. Ireland, iv. 476.
- FLUSTRELLA HISPIDA, *Gray*, B.M. Rad. 108: *Redfern*, Quart. Journ. Micr. Sc. vi. 96, pl. iv.: *Alder*, Cat. loc. cit. 57: *Smitt*, Ups. Univ. Arsskrift, 1863, 12 (sep.).

Zoarium a rather thick brown crust, the surface rendered hispid by numerous reddish-brown corneous spines.
Zoæcia elongate-ovate or subquadrangular, or six-sided,

* In a paper published so long ago as 1851, I have described and figured the transparent case by which the larva of *F. hispida* is protected, showing clearly (in the figure), its bivalve character, and also the mass into which the larva is resolved after fixation. In the same paper an account is given of the development of the polypide out of this (protoplasmic) mass. I believe that this is the earliest notice of the occurrence of a bivalve protective case amongst the Polyzoan larvæ. (See Ann. N. H. for November 1851, (ser. 2, vol. viii.) pl. xiv. figs. 1, 2.)

quincuncially arranged, the front surface flat, smooth and dense ; orifice somewhat raised, bilabiate, bordered above and below by a thin horny rib, the lower one connected with a movable or extensible lip, which acts as an operculum ; a variable number of tall spines surrounding the orifice, and, in many cases, a row of similar appendages along the margins of the cells.

Polypide with 30–35 tentacles.

HABITAT. On various Fuci (*Fucus serratus*, *Gigartina mamillosa*, &c.) between tide-marks.

LOCALITIES. Very common and widely diffused.

GEOGRAPHICAL DISTRIBUTION. Bahusia, 5–10 fathoms (Smitt) ; Finmark (Goës & Malmgren) : Greenland (Lütken) : Heligoland (Kirchenpauer) : Roscoff (Joliet) : France, S.W. (Fischer).

This is in many ways a remarkable form. Its chief structural peculiarities have already been noticed ; but more remains to be said of it. In the size and beauty of its polypides it is unequalled amongst the Polyzoa. Its rather coarse-looking gelatinous crust, bristling with spines, is to be found on almost every coast where the *Fucus serratus* grows, and spreads over many other kinds of weed between tide-marks and in the neighbouring shallow water. The multitudes of the large tentacular bells, when expanded, give rise to the appearance which Sir John G. Dalyell has happily likened to a “thin pale-blue cloud,” interposed between the dark surface and the spectator’s eye. Through the clear still water of the rock-pool on a summer day the blue mist may readily be seen, hovering, as it were, over the masses of *Flustrella* on the weed. The size of the polypide is remarkable : it has often as many as between 30 and 40 tentacles, and is three or four times as large as that of *Alcyonidium mytili*,

which is furnished with eighteen arms, and is by no means a pygmy. The tentacular wreath presents a most elegant campanulate figure, with an everted margin.

In the young cells the form is hexagonal and very regular, the outlines are distinctly defined, and the walls are almost hyaline. At this stage few spines are developed; only an occasional one is to be met with. In many cases these appendages are confined to the neighbourhood of the orifice, around which as many as five to seven are often ranged; but in others they surround the cell, and are placed along the margin in a row, bending inward over the front surface. Apart from this important variation, they differ considerably in number. Each spine rises from a swollen base.

In the older parts of the colony the cells are crowded together, and lose their regularity of form.

Family III.—Arachnidiidæ.

ALCYONIDIADÆ (part.), Hincks (1862): Alder.

ZOECIA *usually more or less distant, membranous.*

Genus ARACHNIDIUM, *Hincks.*

Der. Dim. of ἀράχνη, a spider's web.

ARACHNIDIA, Hincks, Cat. Devon and Cornw. Zooph: Alder.

ARACHNIDIUM, Hincks, Ann. N. H. for Sept. 1877.

GENERIC CHARACTER.—ZOARIUM *membranaceous. ZOECIA usually separate, distant, adnate, united by a more or less filiform prolongation of the cell-wall, so as to form a delicate network.*

IN this genus the massive gelatinous crust, which characterizes the *Alcyonidiidæ*, is replaced by a membranous zoarium. *Arachnidium* may be regarded as an *Alcyonidium* with its cells detached from one another and held together by a slender thread, instead of being immersed in a fleshy crust. Occasionally the cells are massed together; but in general they are separated by considerable intervals, and connected by a filiform extension of the lower extremity, branches being given off from the sides. The habit of the Cheilostomatous genus *Hippothoa* is curiously imitated by this form.

ARACHNIDIUM HIPPOTHOOIDES, Hincks.

Plate LXXI. figs. 1, 2.

ARACHNIDIA HIPPOTHOOIDES, *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 471, pl. xvi. fig. 2.

ARACHNIDIUM HIPPOTHOOIDES (part.), *Alder*, North. Cat., Trans. Tynes. F. C. v. pt. 3, 21 (sep.).

Zoæcia usually rather distant, ovate or lozenge-shaped, of a light horn colour, connected by a slender fibre; orifice marked by a small papilla near the top; branches given off from each side of the cell. *Zoarium* composed of lines of cells, which anastomose and form a very delicate network.

IN this species the connecting fibre is generally well-developed, and the cells are separated by considerable intervals; their form is regular and definite. The branch lines originate at different points on the sides of the zoæcia; most commonly they occur in opposite pairs; but occasionally two are given off on each side; sometimes they originate from the creeping fibre. The orifice is

marked by a small papillary rising; but there is no prominent tube, as in *A. fibrosum*.

In the original description of this form the cells are said to be furnished with marginal processes; and Mr. Alder, in his account of it, states that they occur occasionally. On reexamination, however, I cannot satisfy myself of their existence.

HABITAT. On shells.

LOCALITIES. On a *Cyprina*, dredged off the Isle of Man; on shell, Torbay (T. H.).

ARACHNIDIUM CLAVATUM, Hincks.

Plate LXXI. figs. 3-5.

ARACHNIDIUM CLAVATUM, *Hincks*, Ann. N. H. for September 1877. ser. 4, xx. 216.

ARACHNIDIA HIPPOTHOOIDES, *Norman*, Shetland Pol., Rep. Brit. Assoc. for 1867, 311.

Zoarium forming an irregular network. *Zoæcia* clavate, elongate, enlarged and rounded at the top, and tapering off below; orifice small, placed near the upper extremity.

DISTINGUISHED from *A. hippothooides* by its larger size and its elongated, tapering, club-shaped cells. They are frequently connected directly by the peduncular lower extremity; in other cases this is prolonged into a fibre. Occasionally two or three zoæcia are laid side by side and apparently united. The lateral branches are given off from the upper part of the cell, a little below the orifice.

HABITAT. On the tests of Ascidians, in deep water.

LOCALITIES. Shetland (J. G. Jeffreys): *ibid.* 5-8 miles off Balta, on the test of *Ascidia sordida* (A. M. N.).

ARACHNIDIUM FIBROSUM.

Plate LXXI. figs. 6, 7.

?ARACHNIDIUM HIPPOTHOOIDES (part.), *Alder*, Suppl. Northumb. Cat., Trans. Tynes. F. C. v. pt. 3, 21 (sep.).

Zoæcia irregularly shaped, generally more or less ovate, connected by short anastomosing fibres, which are given off with much irregularity; the margin of the cells set round with very numerous fibrils or filiform processes; orifice long, tubular, projecting.

THE most marked characteristics of this species are the irregular form of the cells, and their numerous marginal processes, and the long and prominent orifice. The connecting threads are generally short, and vary both in number and position; frequently several originate from a cell. The margin of the zoæcia commonly gives off a number of very delicate fibrils, often of considerable length, which spread out in all directions, and constitute a kind of fringe. Sometimes the cells are united at the extremities and form a continuous line; occasionally they are massed together; but in its usual condition the zoarium is a rude and irregular network. The tubular orifice is of very considerable length, suberect, and prominent.

HABITAT. On the tests of Ascidians and on shell.

LOCALITIES. Lulworth Cove; ? Northumberland (*Alder*).

Group *b.* *STOLONIFERA*, Ehlers.

VESICULARINA, Johnston.

LES CENTRIFUGINÉS RADICELLÉS (part.), D'Orbigny.

VESICULARIÆ, Smitt.

ZOARIUM *horny or membranous. ZOÆCIA developed by budding from the internodes of a distinct stolon or stem.*

i. ORTHONEMIDA, Hincks.

POLYPIDES with all the tentacles erect and forming a perfect circle.

Family IV.—*Vesiculariidae*.

ZOÆCIA contracted below, not closely united to the stem at the base, deciduous, destitute of a membranous area. ZOARIUM repent or erect.

a. *Polypides furnished with a gizzard.*Genus *VESICULARIA* (part.), *J. V. Thompson*.

Der. From *vesicula*, dim. of *vesica*, a bladder.

VESICULARIA, J. V. Thompson (part.), Zool. Illust. 1830: Farre: Johnston: &c.

SERTULARIA (part.), Linnaeus: Pallas: &c.

LAOMEDEA (part.), Lamouroux: Blainville.

VALKERIA (part.), Fleming: Dalyell.

GENERIC CHARACTER.—*ZOÆCIA ovate, distant, disposed regularly in a single series on one aspect of the stem. ZOARIUM phytoid, rooted by a fibrous base. POLYPIDE with a small number of tentacles and a gizzard.*

VESICULARIA SPINOSA, Linnæus.

Plate LXXIII. figs. 3-7.

SILK CORALLINE, *Ellis*, Corall. 20, no. 17, pl. xi. figs. *b*, B, C, D.SERTULARIA SPINOSA, *Linn.* Syst. ed. 12, 1312: *Ellis & Sol.* Zooph. 48: *Lamk.* An. s. V. ed. 2, ii. 148.SERTULARIA SERICEA, *Pall.* Elench. 114.LAOMEDEA SPINOSA, *Lamx.* Pol. cor. flex. 208: *Blainv.* Actinol. 474.VALKERIA SPINOSA, *Flem.* B. A. 551: *Dalyell*, Rem. An. i. 251, pl. li. figs. 3, 3 *a*.VESICULARIA SPINOSA, *J. V. Thomps.* Zool. Illust. Mem. v. 98, pl. iii. figs. 1-8: *Farre*, Phil. Trans. 1837, 401, pl. xxii.: *Van Ben.* 'Recherches,' Mém. Acad. Roy. Brux. xviii. 30, pl. iv. fig. C: *Couch*, Corn. Faun. iii. 94, pl. xvii. fig. 1: *Johnst.* B. Z. ed. 2, 370, pl. lxxii. figs. 1-4.

Zoarium confervoid, slender, of very delicate texture, the principal and secondary shoots regularly branched, rooted by a fibrous base; main stems overlaid with many capillary tubes, zigzagged, tapering; branchlets given off from each bend in pairs, which are placed alternately on different aspects of the stem, short, much divided dichotomously, the divisions terminating in spine-like points, jointed above each bifurcation. *Zoæcia* oval, transparent, rather distant, rising from a circular orifice, with raised rim, three to each internode.

Polypide with 8 tentacles.

Height from about 4 inches to a foot.

HABITAT. On stones, oyster-shells, Corallines, weed, &c., from tide-marks to deep water.

LOCALITIES. The Nore (*Ellis*): Guernsey, Fermain Bay; South Devon; Ilfracombe, on weed in rock-pools, and off the Capstone, 8-10 fathoms; Menai Straits; Llandudno; Lytham, Lancashire; Isle of Man; Yorkshire (T. H.): Liverpool (Landsb.): off the Deadman, on Corallines, rare (*Couch*): S.E. of Yarmouth (*Kirchenspauer*): near Hartlepool, rare (*J. Hogg*): Cullercoats,

Northumberland, a single specimen (Alder) : St. Andrews, on rocks near low-water mark (Prof. John Reid) : Leith shore (D. Landsb., jun.) : Wick, rare (C. W. P.) : Shetland (Barlee, *vide* Alder) : Ireland, north, east, and west coasts ; very fine near Dublin (W. T.).

GEOGRAPHICAL DISTRIBUTION. Ostend (Van Ben.) : Roscoff, abundant (Joliet) : Mediterranean (Pallas) : Italy (Kirchenpauer).

V. spinosa grows in tall and graceful shoots, tapering towards the top, and thickly clothed with dichotomously divided and somewhat flabellate branchlets. These are arranged in pairs at each flexure ; and the pairs arise alternately from opposite aspects of the stem, so as to give a full and rounded and almost subverticillate appearance to the whole. From the main stems branches are frequently given off, which are copies of the original shoot ; in large specimens the ramification is luxuriant. The spinous terminations of the branchlets, to which the species owes its name, are not met with on those portions of the zoarium where growth is proceeding : here the tips are rounded and blunt, and the characteristic habit of the species is wanting (Plate LXXIII. fig. 5).

The tubular fibres, which loosely invest the stems for a considerable portion of their length, take their origin on the internodes a little above each bend, and tend downwards, becoming free at the base of the shoot, where they act as rootlets.

The zoarium is singularly delicate in texture and transparent, and the internal structure may be thoroughly investigated with the greatest ease. The endosarc consists of a slender thread, running through the tubular stem from cell to cell, and communicating with each through an orifice at the base ; at each division of the

stem it bifurcates. The zoëcia, which are pretty regularly ovate in form, and so transparent as to keep no secrets, are unilateral, and ranged in single file, diminishing gradually in size towards the end of the branchlets. The polypide is furnished with short stiff tentacles, destitute of the tactile setæ which occur in *Bowerbankia imbricata* and other forms.

Genus AMATHIA, *Lamouroux*.

Der. From *Amathia*, one of the Nereids, according to Homer.

AMATHIA, Lamouroux (1812): D'Orbigny (for species with the cells in continuous series).

SERTULARIA (part.), Linnæus: &c.

SERIALARIA, Lamarck (1816): Fleming: Johnst.: D'Orbigny (for species with the cells in distinct groups): &c.

VALKERIA (part.), Dalyell.

AMATHELLA (sp.), CHARADELLA (sp.), &c., Gray.

GENERIC CHARACTER.—ZOARIUM *consisting of a creeping tubular stem and erect filiform shoots, dichotomously branched. ZOËCIA subtubular, in two parallel rows, disposed in distinct groups, which are placed on one or both sides of the stem, or wind spirally round it; or forming a continuous series.*

D'ORBIGNY has placed the species with the cells in groups and those with the cells in continuous series in two separate genera, applying Lamouroux's name to one and Lamarck's to the other. But the distinction is purely artificial; the structural difference between the two sections is quite unimportant, and they are united by intermediate forms. The species like our own *A. lendigera*, with the cells in distinct unilateral groups, are connected through such forms as *A. alternata*, Lamx., in which the groups are placed alternately on opposite sides, with

those which have them spirally disposed (the latter arrangement being a slight modification of the alternate); and they again (as represented, for instance, by *A. semiconvoluta*, Lamk.) are but a step removed from the species with a continuous spiral winding round the entire stem.

The known species are not numerous; but the genus is widely distributed, ranging from our own shores and the Mediterranean to Japan, the American seas, and Australia.

AMATHIA LENDIGERA, Linnæus.

Plate LXXIV. figs. 7-10.

NIT CORALLINE, *Ellis*, Corall. 27, pl. xv. no. 24, fig. *b*, B.

SERTULARIA LENDIGERA, *Linn.* Syst. 1311: *Pall.* Elench. 124: *Ellis & Sol.* Zooph. 52: *Lister*, Phil. Trans. 1834, 384.

LA SERTOLARA LENDINOSA, *Cavolini*, Polip. Mar. 229, pl. ix. figs. 1, 2.

AMATHIA LENDIGERA, *Lamouroux*, Bull. Soc. Philom. 1812; Pol. cor. flex. 159; Expos. Méth. 10: *Heller*, Bryoz. Ad. Meer. 51.

SERIALARIA LENDIGERA, *Lamk.* Ann. s. Vert. ed. 2, ii. 169: *Flem.* B. A. 547: *Blainv.* Actinol. 476, pl. xxxviii. fig. 2: *Couch*, Corn. Faun. iii. 94, pl. xvi. fig. 4: *Johnst.* B. Z. ed. 2, 368, woodcut, fig. 68: *D'Orb.* Pal. Franç. terr. crét.: *Landsb.* Pop. Hist. 367, pl. xix. fig. 76: *Alder*, Northumb. Cat. 66 (sep.): &c.

VALKERIA LENDIGERA, *Dalyell*, Rem. An. i. 249, pl. lii.

Zoarium much branched, forming dense tangled masses; branches dichotomous, pellucid, obscurely jointed above each division. *Zoæcia* subcylindrical (ovate, compressed laterally), disposed in distinct unilateral groups, placed immediately below a fork, and containing usually from 4-8 cells in each row, which decrease in size towards the upper extremity.

Polypide with 8 tentacles.

HABITAT. On *Fuci* (especially *Halidrys siliquosa*) and zoophytes, from low-water mark to deep water.

LOCALITIES. Very generally distributed, but seems to be less abundant in the north than in the south and west. It is not recorded from Shetland; nor does it occur in the Scandinavian and Arctic lists. Northumberland and Durham, not rare (Alder): Firth of Forth (D. Landsb., jun.): Filey, Yorkshire; Llandudno; Menai Straits; Isle of Man, common; Swanage Bay, in profusion; Ilfracombe, tide-marks and 8-10 fathoms; South Devon, in great luxuriance, chiefly on *Halidrys* (T. H.): Isle of Wight (W. T): Hastings, somewhat rare (Miss Jelly): Sussex, frequent (Pallas): Tenby (F. Walker): Cornwall (C. W. P.): north, east, and west coasts of Ireland (W. T.): Youghal (Miss Ball).

GEOGRAPHICAL DISTRIBUTION. Roscoff, at all depths, especially on fibrous Algæ in the *Zostera*-beds (Joliet): France, S.W. (Fischer): coast of Belgium (Pallas): Posilipo, St. John's Grotto (Cavolini): Adriatic, on Algæ and zoophytes (Heller): South Africa, the present species or one closely resembling it (Busk).

This pretty species is diffuse and luxuriant in its habit of growth, and overspreads the Algæ and corallines, in which it delights, with a perfect tangle of its delicate, flexile stems. As Ellis has remarked, "it climbs up and runs over other Corallines and Fucuses as Dodder does over other plants." It is truly scandent in its habits, and not only attaches itself by means of its slender intertwining branches, but also gives off here and there at times, as the ivy does, delicate fibrils, which seize the nearest support, and secure, as it were, a new starting-point for its vigorous growth.

The zoœcia, which form the isolated groups, are ranged in two contiguous parallel rows, those in each row being closely united to one another. They become gradually

shorter towards the upper extremity of the group, and imitate in their arrangement "the antique figure of Pan's pipe." The surface, both of the stem and cells, is speckled.

Genus BOWERBANKIA, *Farre*.

Der. Named in honour of Dr. Bowerbank.

BOWERBANKIA, *Farre*, Phil. Trans. (1837): Johnston: Van Beneden: &c.

SERTULARIA (part.), *Adams*: &c.

VALKERIA (part.), Johnston, B. Z. ed. 1: Hassall: Couch.

SERIALARIA (part.), Templeton.

GENERIC CHARACTER.—ZOECIA *ovate, disjunct, clustered, often subspirally arranged*. ZOARIUM *repent or erect*. POLYPIDE *with a small number of tentacles (8-10) and a gizzard*.

THE genus *Bowerbankia*, as founded by Dr. Farre, was distinguished from *Valkeria* auctt. by the possession of a gizzard, and embraced a single species. We now know that there is a wider range of difference between these two forms; and it has been necessary to remove the latter to a distinct group (*Campylonemida*), of which it constitutes the type.

In his genus *Valkeria*, Dr. Johnston has included the *Sertularia pustulosa* of Ellis and Solander; but this form is furnished with a gizzard, and agrees with *Bowerbankia* in the arrangement of the tentacles and in general structure, and should undoubtedly be united with it. The slight difference between them in the *number* of arms (the one has 10 and the other 8) is a point of no special importance. One or two other species have occurred since Johnston's time, which bear a general resemblance to *B. pustulosa*, and will rank with it in the

same genus. They all possess eight tentacles; they are of slighter build and more delicate habit than *B. imbricata*, and the structural features are less strongly pronounced than in the latter, but there are no differences between them of generic value. They are all furnished with the manducatory organ, and have the arms arranged in a perfect circle.

Little is known as yet of the distribution of the *Ctenostomata* generally. The forms have been so imperfectly discriminated that some doubt necessarily attaches to the identification of the species, and at the same time the comparative difficulty of preserving them has greatly limited our knowledge of the foreign members of the group.

The genus *Bowerbankia* has one representative at least on the northern coasts of America (*B. gracilis*, Leidy); it has occurred in the Caspian Sea; and I have detected specimens of *B. imbricata* form *densa* on an *Alcyonidium* from the White Sea, for which I am indebted to M. Mereschowsky. Smitt records it from Norway and Spitzbergen.

Valkeria Vidovici of Heller, from the Adriatic, is also probably referable to this genus*.

BOWERBANKIA IMBRICATA, Adams.

Plate LXXIII. figs. 1, 2.

SERTULARIA IMBRICATA, *Adams*, Linn. Trans. v. 11, pl. ii. figs. 5-11: *J. V. Thomps.* Zool. Illust. 94, pl. i. figs. 1-4.

VALKERIA GLOMERATA, *Coldstream*, Edinb. N. P. Journ. ix. 235, pl. ii. figs. 1, 2.

SERIALARIA IMBRICATA et VERTICILLATA, *Templeton*, Mag. Nat. Hist. ix. 467, fig. 66.

VALKERIA IMBRICATA, *Johnst. B. Z.* ed. i. 254: ? *Couch*, Corn. Faun. iii. 95, pl. xvii. fig. 2.

* Kirchenpauer mentions a Vesicularian, apparently allied to *B. pustulosa*, which had been brought by Dr. v. Martens from Yokohama.

- BOWERBANKIA IMBRICATA, *Johnst. B. Z.* ed. 2, 377, pl. lxxii. figs. 5, 6: *Alder*, Northumb. Cat. loc. cit. 67 (sep.): *W. Thompson*, N. H. Irel. iv. 466: *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 473 (59, sep.): *Joliet*, Bryoz. d. côtes de France, 102, &c. (Not *B. imbricata*, Gosse, Mar. Zool. ii. fig. 39.)
- BOWERBANKIA Densa, *Farre*, Phil. Trans. 1837, 391, pls. xx. & xxi.: *Johnst. B. Z.* ed. 1, 255: *Van Ben.* Rech. 29, pl. iv. fig. A (Mém. Brux. xviii.).

Stem tubular, creeping (*B. densa* auctt.) or erect, and irregularly branched (*B. imbricata*)*. *Zoæcia* large, ovato-cylindrical, transparent, broad and squarish at the top, somewhat narrowed below, disposed in groups along the creeping stolon, or in irregular clusters (sometimes almost continuously) on the erect stems and branches.

Polypide with 10 tentacles, furnished with a row of about 12 tactile setæ on the back: gizzard large and powerful.

Height of the erect form 1-3 inches.

IN its erect form this species grows in "bushy, flaccid tufts," much and irregularly branched, and attains a very considerable size. The cells are arranged in large, dense clusters along the stem, either on one aspect of it only, or (not unfrequently) on all sides of it. Occasionally the groups blend, and the zoæcia range almost continuously along the branches. The stem is stout and smooth, and of a decided horn-colour. In its humbler form *B. imbricata* spreads on the surface of Algæ, stones, &c., the cells being grouped at intervals on the creeping stolon. The common *Corallina* is a favourite habitat; and on this it forms compact suborbicular tufts, which completely surround the stem.

* "Au printemps * * * on trouve abondamment la forme *densa* de la *Bewerbanksia* composée d'une quantité de loges dressées sur la surface de l'Algue et pressées l'une contre l'autre de manière à ne former qu'un tapis. Plus tard se détachent de ce groupe des stolons, puis des rameaux libres qui poussent des branches et, se garnissant de paquets de loges, reproduisent la forme *imbricata*."—JOLIET, *Bryozoaires des côtes de France*.

The cells are large and stout, and somewhat squared at the top, during retraction. Through the transparent walls the polypide, which exhibits the most highly specialized form of the Ctenostomatous structure, can be readily examined*. It has ten tentacles, which are not everted at the extremities, and form a rather slightly expanded bell. They are furnished with numerous bristles, ranged in a single line along the back. Joliet states that in the case of the erect form he has frequently met with only eight tentacles; ten, however, seems to be the prevalent and normal number.

In summer, when reproduction is proceeding, the colonies are tinted red by the larvæ which occupy the cells.

HABITAT. On various Fuci, *Corallina officinalis*, other Polyzoa (*Flustra*, *Vesicularia*, &c.), on the underside of stones, &c., from between tide-marks (chiefly) to deep water (?).

LOCALITIES. Very common and generally distributed.

GEOGRAPHICAL DISTRIBUTION. White Sea, on *Alcyonium* (Mereschkowsky): Caspian Sea (O. Grimm): Ostend (Van Ben.): Roscoff, on *Fucus serratus* and *Fucodium nodosum* (chiefly), also on *Cystoseira*, in the Laminarian zone; especially fine and abundant in brackish water (Joliet).

BOWERBANKIA CAUDATA, Hincks.

Plate LXXV. figs. 7, 8.

VALKERIA CAUDATA, Hincks, Ann. N. H. ser. 4, xx. 215 (1877).

Stem creeping. *Zoæcia* elongate, subcylindrical, biserial, opposite, truncate at the top, slightly narrowed below,

* It is the subject of one of Dr. Farre's classical memoirs, which have contributed so largely to our knowledge of the anatomy and physiology of the Polyzoa.

and produced at the base into a short, pointed, caudate process, which bends outwards; disposed in companies along the creeping stem.

Polypide with 8 tentacles.

IN the original account of this species I have stated that I had been unable to detect a gizzard. But I have since had the opportunity of examining a considerable number of well-preserved specimens; and I find that this organ is present and well-developed, and that the structure generally agrees with that of *Bowerbankia*.

The cells are much smaller and slenderer than those of *B. imbricata*, and are not so broad and squarish at the top as the latter. Below they terminate in a pointed, somewhat spur-like extremity, which is very conspicuous in the youngest cells, but is often less apparent in the adult. The cell is attached at a point a little above the base; and the extremity commonly bends outwards. Normally the zoœcia are disposed in separate groups or companies along the stem, and are placed opposite to one another with much regularity; but in certain states they are more crowded together, and the clusters almost blend.

I have little doubt that *B. caudata* will prove to be far from uncommon; it has probably been confounded with *B. imbricata*.

HABITAT. On Algæ, from moderate depths.

LOCALITY. Ilfracombe (Leipner).

BOWERBANKIA PUSTULOSA, Ellis & Sol.

Plate LXXVI. figs. 1-5.

DICHOTOMOUS TUBULAR CORALLINE, *Ell.* Corall. 54, pl. xxvii. fig. c, B.

SERTULARIA PUSTULOSA, *Ell. & Sol.* Zooph. 54: *Flem.* Br. An. 551.

VESICULARIA PUSTULOSA, *J. V. Thompson*, Zool. Illust. 99, pl. i. figs. 5-11.

VALKERIA PUSTULOSA, *Johnst.* B. Z. ed. 2, 376, pl. lxvii. figs. 7-9: &c.

Zoarium erect, phytoid, much branched dichotomously, jointed, branches given off just below a joint, blunt at the extremities; stem flexuous, rather stout, of a light horn-colour. *Zoæcia* ovate, disposed at intervals in groups along the stem and branches, a group on each internode, subspirally arranged in two series; the clusters dense, elongated, occupying generally about two thirds of the internode, narrowed below and widening upwards.

Polypide with 8 tentacles.

Height 2 or 3 inches.

FROM the large size of the clusters of cells, this species has a comparatively stout habit. It grows in tall and dense arborescent tufts, sometimes attaining a height of four inches. The zoæcia, during the retraction of the polypides, are contracted above, and, for a short distance below the extremity, transversely striated. Their sub-spiral arrangement is very apparent in the young terminal clusters.

The polypide is furnished with a gizzard, which is small as compared with that of *B. imbricata*; indeed there is a delicacy in the entire structure which is wanting in the latter. The œsophagus is very long; whilst the stomach is short and slender, and pointed below. The setose operculum is a remarkably beautiful object, and is composed of about twenty tall and extremely delicate bristles, united by a membranous sheath of extreme tenuity.

HABITAT. On Fuci &c., in shallow water.

LOCALITIES. Isle of Wight (Ellis): Cork Harbour (J. V. Thompson): Youghal (Miss Ball): Dublin Bay (Hassall): Belfast Bay (W. T.): Menai Straits; Llandudno; Ilfracombe, extremely abundant off the Capstone; Salcombe Bay, plentiful (T. H.): Fowey Harbour, and off Goran, Cornwall, very rare (C. W. P.): Leith shore, rare (D. Landsb., jun.).

BOWERBANKIA CITRINA, Hincks.

Plate LXXVI. figs. 6-8.

VALKERIA CITRINA, *Hincks*, Ann. N. H. ser. 4, xx. 215 (1877).? VALKERIA IMBRICATA, *Dalzell*, Rem. An. i. 246, pl. 1.

Stem erect, slender, dichotomously branched. *Zoæcia* clustered, somewhat spirally disposed, oval, small and delicate, not densely crowded; the clusters short, placed immediately below each bifurcation, and occupying about the upper half of the internode or less.

Polypide of a citron colour, with 8 tentacles: very tall when expanded.

Shoots clustered, of slender habit, forming bushy tufts.

From the preceding species *B. citrina* is distinguished by its smaller size and more delicate habit, by its short and not very dense companies of cells, which do not extend far below the joint, whilst those of the kindred species are elongated and compact and occupy a large proportion of the internode, and by the exquisite colour of the tentacles and other portions of the polypide.

This might perhaps be regarded as a variety of *B. pustulosa*, were it not that the differences in habit (which are so striking that the two forms are distinguished at a glance) are always associated with the remarkable peculiarity in the colour of the polypides. The coloured portions are the tentacles and a line running down the body and probably marking the course of the œsophagus. Each of the arms is traversed by a central line of bright citron-coloured granules.

The polypides of this species are most beautiful objects, both when stowed away in their transparent cells and when expanding their tinted wreaths of tentacles.

HABITAT. On rocks near low-water mark, and in shallow water.

LOCALITIES. Ilfracombe, the Tunnels, and dredged off the Capstone (T. H.).

BOWERBANKIA GRACILLIMA, Hincks.

Plate LXXV. fig. 6.

VALKERIA GRACILLIMA, *Hincks*, Ann. N. H. Sept. 1877, 216.

Stem creeping, rather stout, and sinuous. *Zoæcia* disposed in groups of varying size at intervals, slender, elongate-oval when contracted, flask-shaped when the polypide is extended, rounded off below, of a light horn-colour.

Polypide with 8 tentacles.

THIS species is not characterized by any very marked feature, but is very distinct notwithstanding from any form with which I am acquainted. The cells originate on the sides of the creeping stem, but are not regularly biserial; they are very slender and graceful in form, and are considerably larger than those of *B. pustulosa* and *citrina*. The gizzard is very conspicuous. Along the back of each tentacle runs a line of very delicate setæ; and two or three stand out very prominently at the extremity. A very long bristle also projects at the base, and is visible standing out on each side at the bottom of the tentacular bell.

HABITAT. On *Corallina* and stones between tide-marks.

LOCALITIES. Ilfracombe, probably (Leipner): Salcombe, in rock-pools; Torquay, tide-marks (T. H.).

Genus AVENELLA, *Dalyell*.Der. Dim. of *avena*, oats.AVENELLA, *Dalyell*, Rem. An. Scotland : Wyville Thomson.

GENERIC CHARACTER.—ZOECIA *solitary, irregularly scattered, subunilateral, curved, and slightly contracted above. STEM repent, nearly simple. POLYPIDES with numerous tentacles and a small gizzard.*

THERE has been some strange misapprehension amongst authors respecting this well-marked form. Notwithstanding the figures and excellent descriptions of it which we have from Sir J. G. *Dalyell* and Sir Wyville Thomson, it has been perseveringly identified by several of our recent writers on the Polyzoa with the *Cylindracium dilatatum* of the present work, a species with which it has little in common. Indeed the two forms belong to different families. *Avenella* is furnished with distinct, deciduous cells ; whilst the species with which it has been confounded has its cylindrical zoecia closely and permanently united to the creeping stem.

It is somewhat remarkable that a form which Sir Wyville Thomson describes as “one of the largest and most conspicuous of our Vesicularian Polyzoa,” and which seems to be abundant on certain parts of the coast, should have attracted hitherto so little attention and been so generally misunderstood.

Avenella is separated from the other members of the family by the peculiarities of its cell and its large number of tentacles.

AVENELLA FUSCA, Dalyell.

Plate LXXVII. figs. 6, 7.

AVENELLA FUSCA, *Dalyell*, Rem. An. ii. 65; i. pl. xii. fig. 11. (Not *Farrella fusca*, Busk, Q. J. Micr. Sc., nor *Avenella fusca*, Alder, Northumb. Cat., nor *Valkeria fusca*, Smitt, loc. cit. 502, pl. xiii. fig. 38.)

AVENELLA DALYELLII, *Wyville Thomson*, Ann. N. H. ser. 2, ix. (1852), 403, pl. xvi. B.

Stem very much attenuated, "much matted and interwoven." *Zoæcia* large (about $\frac{1}{16}$ inch long), set at irregular intervals, and not in the same line, more or less curved, roughened with scattered horny bristles, of a brown colour.

Polypide with 20-24 tentacles.

A. FUSCA is remarkable for luxuriant growth, and forms "dense tangled masses." Its cells, according to Sir W. Thomson, are not unlike the ergot of rye.

HABITAT. On Sertularian hydroids, chiefly from rather deep water.

LOCALITIES. Scotland, on zoophytes, "or on sluggish animals," e. g. *Hyas araneus* (Dalyell): Newhaven, amongst rejectamenta of the oyster-dredges, on various species of *Halecium* and other corallines; off Port Appin, Argyllshire, on *Diphasia pinaster*; Dogger bank (Sir Wyville Thomson).

b. *Polypides destitute of a gizzard.*Genus FARRELLA, *Ehrenberg.*

Der. Named in honour of Dr. Farre.

FARRELLA, Ehrenberg, Abhand. König. Akad. d. Wissensch. zu Berlin, 1838:
Johnston: Hincks.

LAGANELLA *, Farre, Phil. Trans. (1837): W. Thompson: Hassall.

LAGUNCULA, Van Beneden (1845).

GENERIC CHARACTER.—ZOECEIA *with a bilabiate orifice, elliptical, scattered.* ZOARIUM *repent.* POLYPIDES *without a gizzard.*

THE most important distinction between the present form and *Bowerbankia* is to be found in the absence of the gizzard, which is so striking a feature of the latter genus. *Farrella* is also distinguished by the bilabiate orifice of its cell. But there are also differences in the general cast of its structure; and we have in this genus, on the whole, a less highly specialized form than *Bowerbankia*. In the latter the œsophagus is of great length, the gizzard is a highly organized and powerful structure, and the tentacles are furnished with an apparatus of tactile setæ, which is wanting in the present genus.

Dr. Farre has also noticed a difference between the two forms in the position of the stomach during retraction. In *Farrella* it is never brought down to the bottom of the cell, but remains suspended from the upper part of it by the intestine. Altogether the differences between the polypides of the two genera are of much significance.

Smitt is inclined not to attach so much importance as Farre to the presence or absence of the gizzard. He has

* This name had been previously applied (1832) to a Protozoon.

noticed that within the limits of one colony this organ is in some cases very conspicuous and fully developed, that in others it is destitute of its dark colour, less completely developed, and much less apparent, while in others, again, it seems to be absent. He appears to think that this character is hardly to be trusted as a diagnostic. My own experience certainly does not support this view. I cannot remember that I have ever met with a cell of *Bowerbankia imbricata* (for instance) in which the gizzard was not well developed and a conspicuous feature.

If it be occasionally absent in species which are usually furnished with it, this exceptional fact would hardly affect its importance as an element of structure.

The ova are liberated in this genus, according to Van Beneden, through an orifice at the base of the tentacular wreath.

FARRELLA REPENS, Farre.

Plate LXXVIII. figs. 5, 6.

LAGENELLA REPENS, *Farre*, Phil. Trans. 1837, 403, pl. xxiv. : *W. Thompson*, N. H. Ireland, iv. 464 (not *L. repens* of Hassall).

BOWERBANKIA REPENS, *Johnst.* B. Z. ed. 1, 256.

LAGUNCULA REPENS, *Van Ben.* Recherches &c., "Sur l'organisation des *Laguncula*," Mém. Acad. Roy. Bruxelles, xviii. 25, pl. i. and pl. ii. A.

LAGUNCULA ELONGATA, *id.* loc. cit. 26, pl. ii. B.

FARRELLA PRODUCTA, *Hincks*, Ann. N. H. ser. 2, viii. 361, pl. xiv. fig. 10.

FARRELLA REPENS, *Johnst.* B. Z. ed. 2, 380, woodcut, fig. 58 (after Farre).

Stem repent. *Zoæcia* oblong, transparent, springing irregularly from the sides and upper surface of the stem, pedunculate, the peduncle much shorter than the cell.

Polypide usually with 12 tentacles, which are destitute of setæ ; occasionally with 10 or 11.

Form *elongata*. With the peduncle as long as the cell, or longer.

Polypide with 10–16 tentacles; 12 I have found to be the usual complement.

WE can hardly, I think, regard the difference in the length of the peduncular portion of the cell in the two forms (*repens* and *elongata*) as more than varietal, as they seem to agree in all other respects. The usual number of the tentacles in both is twelve; but there are slight irregularities.

As to the distribution of the species, it is somewhat peculiar that the *elongata* form, which is too remarkable readily to escape observation, has only been noticed on certain portions of the Lancashire coast, where it occurs in amazing profusion, investing all kinds of marine substances. For the form *repens* we have only one or two British localities; but it may be more easily overlooked or confounded, on slight examination, with *Bowerbankia*.

From the extreme tenuity and transparency of the ectocyst, the internal structure can be studied to the greatest possible advantage in this species. It forms the subject of an admirable memoir by Van Beneden.

HABITAT. Carapace of crabs, shells, Algæ, Hydroids, &c.

LOCALITIES. Isle of Sheppey, not very common (Farre): Strangford Lough, on Algæ (W. T.).

Form *elongata*. Fleetwood, on a buoy; Lytham, extremely abundant (T. H.).

GEOGRAPHICAL DISTRIBUTION. Ostend, very common, especially on *Sertularia*, *Tubularia*, and *Flustra* (Van Beneden): Caspian Sea (Grimm).

Form *elongata*. Ostend, on the carapace of the common crab (Van Beneden).

Family V.—Buskiidæ.

VESICULARIADÆ (part.), Alder.

ZOÆCIA *contracted below, not continuous with the creeping stolon, with an aperture on the ventral surface.*

Genus BUSKIA, Alder.

Der. Named in honour of Prof. Busk.

BUSKIA, Alder, Trans. Tynes. Nat. F. C. (1857).

GENERIC CHARACTER.—ZOÆCIA *corneous, flask-shaped, decumbent, adherent for a great part of their length, developed at intervals from a creeping tubular stem; a membranous area on the ventral (or under) side immediately below the orifice.* POLYPIDE *with a small number of tentacles. Gizzard?*

SEVERAL genera contend for the honour of bearing Mr. Busk's name; but there seems to be no doubt that Mr. Alder's *Buskia* was the first in the field. The well-deserved tribute is enhanced in value, coming, as it does, from so accurate and accomplished a student of the Invertebrata.

In this genus there is an "aperture" on the under or ventral side of the zoæcium, which is covered by a thinner material than that of which the upper portion of the cell is composed. This aperture corresponds with the similar structure which we find in *Triticella* and *Mimosella*, and represents the membranous area of the *Cheilostomata*, on which the oral operculum is placed. It occupies the whole space between the terminal orifice and the point at

which the cell becomes adherent. This portion of the cell bears a somewhat close resemblance to the end of a quill prepared for pen-making. I am inclined to think that the membranous area extends also over the adherent part of the zoëcia ; for, when detached, the lower wall is generally found to have disappeared, as if it might have been formed of more delicate material than the rest. This structural peculiarity must separate the present genus from the *Vesiculariidae*.

BUSKIA NITENS, Alder.

Plate LXII. figs. 6, 7 ; and Woodcut, fig. 28.

BUSKIA NITENS, Alder, North, Cat. loc. cit. 66. pl. v. figs. 1, 2 : Quart. Journ. Micr. Sc. v. (1857) 24, pl. xiii. figs. 1, 2.

Stem slender, branching or anastomosing, with occasional short spinous offshoots. *Zoëcia* minute, glossy, flask-shaped, rather ventricose, the anterior portion free and slightly turned upwards, tapering towards the orifice, which is terminal and placed at the top of a membranous area, occupying the under surface of the free neck-like portion of the cell ; irregular, flattened, and adherent spines given off from the sides of the cell.

Polypide with 8 shortish and rather stout tentacles.

BUSKIA NITENS, though abundant, is so minute and inconspicuous that it readily escapes observation, and very few localities for it have hitherto been recorded. It ranges to extreme northern latitudes, where it occurs in a profusion which shows the conditions of life to be congenial. The stems and calyces of the various species of *Laföëa* are a favourite habitat, and are often overspread with its bright insect-like cells. I have also found it creeping over

Crisia cornuta, and even running up its long slender setæ, which were literally clasped by the spinous base of the cell.

There is very great irregularity in the development of the processes round the base of the zoëcium. They seem to be occasionally wanting altogether; in other cases they are short and very numerous, in others again, fewer in number and more produced.

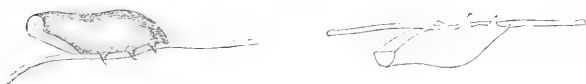
The neck-like prolongation of the zoëcia in front is variable in length; it is quite free and slightly turned upwards, and its underside is occupied by the aperture, which is closed in by a membranous covering. The cells are laid alongside the stem, to which they are attached by the lower extremity. They are remarkable for their smooth and shining surface; and the species well deserves its name.

HABITAT. On various kinds of Hydroida and Polyzoa, &c., and occasionally on stone, from tide-marks to deep water.

LOCALITIES. Northumberland, on *Hydrallmania*, *Lafoëa*, &c., deep water, rather rare (Alder): Whitley, on stone at low-water mark (J. Coppin): Guernsey; Salcombe Bay, on *Lafoëa dumosa*; off Lulworth Cove; Llandudno; Filey; Whitby (T. H.): Wick, on *Sert. abietina* (C. W. P.): Shetland, on *Halecium labrosum* (Barlee).

GEOGRAPHICAL DISTRIBUTION. Davis Straits, on Hydroids, 100 fathoms (Wallich): White Sea, on *Lafoëa* (Mereschkowsky).

Fig. 28.



Buskia nitens.

Family VI.—Cylindræciidæ.

VESICULARIADÆ (part.), Busk, Quart. Journ. Micr. Sc. : Alder : Hincks.
VESICULARIÆ (part.), Smitt, Krit. Förteckn.

ZOÆCIA not contracted below, closely united to the stem at the base, not deciduous; destitute of a membranous area.

IN this family the zoæcium is not an isolated chamber contracted below and only communicating with the common stem through a small orifice at the base, as amongst the *Vesiculariida*, but is closely and permanently united to the stem and preserves its cylindrical form pretty uniformly to the point of junction with it. In some species it rises from an expansion in the course of the creeping stolon, with which its walls are continuous, and which must be regarded as a decumbent portion of the cell itself. During retraction the polypide is sometimes partially withdrawn into it. This expansion of the stem, now constituting the basal portion of the zoæcium, may be compared with the similar structures in *Aetea* and *Eucratea*, and must probably be regarded as representing the primitive condition of the cell.

Throughout the family the ectocyst, or wall of the zoæcium, is more or less charged with earthy particles, which render it opaque.

Genus CYLINDRÆCIUM.

Der. From κύλινδρος, a cylinder, and οἶκιον, a house.

FARRELLA (part.), Busk : Gosse : Hincks.

AVENELLA, Alder : Hincks : Gosse (*not* Dalyell).

VALKERIA (part.), Smitt.

GENERIC CHARACTER.—ZOÆCIA *elongate, cylindrical, crowded together or scattered, rising from a creeping stolon. POLYPIDE without a gizzard.*

CYLINDRÆCIUM GIGANTEUM, Busk.

Plate LXXVII. figs. 3, 4.

FARRELLA GIGANTEA, *Busk*, Quart. Journ. Micr. Sc. iv. 93, pl. v. figs. 1, 2 :
Gosse, Mar. Zool. pt. ii. 22, fig. 40.

AVENELLA GIGANTEA, *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. 473 (59,
sep.).

Zoæcia tubulous, thickly crowded together, the walls rendered dark and opaque by imbedded earthy matter, of great length (occasionally more than $\frac{1}{8}$ inch), not decumbent at the base.

Polypide with 18–20 tentacles.

In a specimen of this species from Tenby, which I owe to Mr. Busk, the cells are densely crowded together on the stolon ; and he describes it as “growing in a close and thick pile” on the walls of the cave where it was discovered. The length of the cell is remarkable, and also the opacity of the ectocyst, due to the very large quantity of earthy matter with which it is charged. I have never been able to detect any dilatation of the stem at the base of the zoæcia in *C. giganteum*.

HABITAT. On rocks near low-water mark.

LOCALITY. Tenby (Busk).

CYLINDRÆCIUM DILATATUM, Hincks.

Plate LXXVII. figs. 1, 2; Plate LXXIX. figs. 1-3.

FARRELLA DILATATA, *Hincks*, Proc. Dubl. Un. Zool. & Botan. Assoc. ii. pt. 1 (1860), 78; Q. J. Micr. Sc. viii. 279, pl. xxx. fig. 7.

AVENELLA DILATATA, *id.* Dev. Cat., Ann. N. H. ser. 3, ix. 473 (60, sep.).

FARRELLA FUSCA, *Busk*, Q. J. Micr. Sc. iv. 94, pl. iii. fig. 6.

AVENELLA FUSCA, *Alder*, North. Cat. 69 (sep.): *Norman*, Shetl. Polyz., Rep. Brit. Assoc. 1867, 311.

VESICULARIA FUSCA, forma SIMPLEX, *Smitt*, loc. cit. 503 and 524, pl. xii. fig. 38.

Stem slender, anastomosing, dilating at intervals into an expansion, which forms the basal part of the cell, and from which the erect tubular portion rises; this expansion is frequently set round with spinous processes. *Zoœcia* rather distant, tubulous, of moderate length, decumbent towards the base, the walls opaque, having the appearance of being sanded over with very minute particles.

Polypide with about 18-20 tentacles.

THIS form has been identified by most recent writers on the Polyzoa with the *Avenella fusca* of Dalyell, with which (as I have pointed out in the account of that species) it has no close affinity whatever.

It is distinguished from *C. giganteum* not merely by the size of its cells (which, though very variable, are always much smaller than those of the latter species), but more markedly by the expansion of the creeping stolon, constituting the basal portion of the zoœcium. The ectocyst is also less laden with earthy matter, and therefore much less opaque and coarse in appearance than that of *C. giganteum*. The cell is of about equal size throughout, and is continuous below with the expansion of the creeping stem, which is a striking characteristic of the species. This varies, to some extent, in size and figure. When

C. dilatatum grows on the frond of a *Flustra* or the stem of some other Polyzoon, it is inconspicuous and often difficult to detect. But when it spreads over the surface of a shell, it frequently attains a comparatively large size, and is furnished round the edge with a number of spinous projections, which give it very much the appearance of the cell of *Buskia nitens*. Under such circumstances the species presents a very altered appearance (Plate LXXIX. figs. 1-3). From each side of the dilatation a branch is generally given off a little below the termination of the erect portion of the zoëcium; and frequently one or two more are present. This branching may remind us of that of *Aetea* amongst the *Cheilostomata*.

HABITAT. On various Polyzoa and Hydroida, tests of Ascidians, and shells, from shallow to deep water.

LOCALITIES. Antrim (Hyndman): South Devon; Ilfracombe; Llandudno; Isle of Man; Oban (T. H.): Cultercoats, Coralline zone (Alder): Shetland, deep water (A. M. N.): Wick (C. W. P.).

GEOGRAPHICAL DISTRIBUTION. Bahusia (Smitt): Roscoff, on *Cellaria* and *Lepralia foliacea*, abundant (Joliet).

CYLINDRÆCIUM PUSILLUM.

Plate LXXX. fig. 8*; and Woodcut, fig. 29.

Zoëcia minute, scattered, tubular, slightly bent, rendered more than semi-opaque by the presence of minute earthy (? sandy) particles in the walls, the lower portion decumbent and continuous with the creeping stem.

Polypides small, with about 10 short tentacles.

* This figure is defective in not showing the decumbent portion of the cells (see woodcut, fig. 29).

THIS is a very small species, with a slender cell, which declines very markedly to one side on the retreat of the polypide. The walls of the zoecium have the appearance, under a high power, of being coated with minute granules.

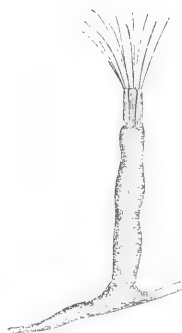
The creeping stem dilates slightly and gradually at the base of each of the erect tubes; the expansion thus formed constitutes the lower extremity of the cell; and into the decumbent portion of its dwelling the polypide, during complete retraction, is partially withdrawn.

This is an inconspicuous form, which is to be found creeping over the roots of *Laminariæ* near low-water mark. It has all the characters of a typical member of the genus, but differs from its congeners in its minute size and delicate habit and the small number of its tentacles. I have met with a still minuter form (Plate LXXX. fig. 9), bearing a close general resemblance to the present, of which it may perhaps be a dwarf variety. It is often extremely difficult to examine the minuter Ctenostomatous species, not merely on account of their size, but from the nature of their habitats; and I have little doubt that many exist on our shores which have, so far, escaped detection.

HABITAT. On tangle-roots &c. within tide-marks.

LOCALITIES. The Castle rocks, Salcombe; the Capstone, Ilfracombe (T. H.)

Fig. 29.



C. pusillum.

Genus ANGUINELLA, *Van Beneden*.

Der. from *anguis*, a snake; named from its supposed affinity with the genus *Anguinaria*.

ANGUINELLA, Van Beneden, Rech. sur les Bryoz. (1844): Busk.

GENERIC CHARACTER.—ZOARIUM *consisting of an erect common stem, giving off branches at intervals, on which the cells are borne; the ectocyst incrustated by earthy matter, opaque. ZOECIA cylindrical. POLYPIDES without a gizzard.*

ANGUINELLA PALMATA, Van Beneden.

Plate LXXVII. figs. 5, 5 a; and Woodcut, fig. 30.

ANGUINELLA PALMATA, *Van Beneden*, Recherches, &c. (Mém. Bruxelles, xviii.), 58, pl. vii. figs. 18-24: *Busk*, Q. J. Mier. Sc. iv. (1856), 95, pl. vi. figs. 1, 2.

Zoarium attached by the base, dendroid, thickly branched; the branches clothing the stem from the base to the summit, more or less palmate, of an earthy-brown colour. *Zoecia* cylindrical, irregularly distributed on the branches, with which they are continuous below, slightly bent inwards.

Polypides with 10 short tentacles, clothed with remarkably long cilia.

Height from 3 or 4 to 6 or 8 inches.

VAN BENEDEN likens this curious species to a fir-tree clothed with branches to its very base. Mr. Busk gives a better idea of it in saying that it "resembles a small *Fucus* covered with mud."

It requires a keen and practised eye to detect it in the muddy situations in which it chiefly delights; and, indeed, without a previous knowledge of its peculiarities it is pretty sure to escape observation or to be passed by as a weed. The cells are rendered very dark-coloured and opaque by the large quantity of earthy matter imbedded in their walls. They are generally curved slightly inwards towards the stem; they are not contracted at the base, and have rather the appearance of processes of the branch than of distinct cells.

HABITAT. On shells, dead or living, stones, &c., between tide-marks, especially in muddy situations and in shallow water.

LOCALITIES. River Deben, Suffolk, abundant on oyster-shells; Tenby, caves in St. Catherine's Isle, sparingly (Busk): Filey, between tide-marks (T. H.): Ilfracombe (Allman).

GEOGRAPHICAL DISTRIBUTION. Ostend, very abundant, especially in autumn (Van Ben.): Charleston, South Carolina (Dr. Harvey).

Fig. 30.

*Anguinella palmata.*

Doubtful Species.

NOLELLA STIPATA, Gosse.

NOLELLA STIPATA, Gosse, Mar. Zool. ii. 21, fig. 38.

Zoæcia erect, subcylindrical, crowded on tubes which form an undefined incrusting mat. *Polypide* with 18 tentacles.

Probably referable to *Cylindracium*.

Family VII.—Triticellidæ.

TRITICELLIDÆ, G. O. Sars.

VESICULARIADÆ (part.), Alder.

HIPPURARIADÆ, Busk (for the genus *Hippuraria*).

ZOÆCIA horny, with an aperture and membranous area on the ventral aspect; borne on a rigid peduncle, to which they are attached by a movable joint, deciduous.

ONE of the characteristics of this remarkable group is the presence of an aperture or area, with a membranaceous covering, on the ventral aspect of the cell. This is the representative (as before remarked) of the aperture which exists in many of the *Cheilostomata*, and may remind us especially of the form of it which we find in the genus *Aetea*. Through this genus, on the one hand, and *Triticella* and *Cylindræcium* on the other, as Smitt and G. O. Sars have already pointed out, the two great divisions of the *Ctenostomata* and *Cheilostomata* are very closely and firmly linked together.

Sars goes so far as to place *Triticella* amongst the latter; but the *Ctenostomatous* character seems to me to preponderate in this form, and the *Cheilostomatous* in *Aetea*.

The presence of a setose operculum and a corneous ectocyst, and the absence of an oral lid or valve, are eminently characteristic of the present suborder; and in all these points *Triticella* is *Ctenostomatous*. The aperture is a prevalent *Cheilostomatous* character; but *Triticella* is not the only *Ctenostome* which possesses it. It exists also in *Buskia* and *Mimosella*, and may probably be detected in other forms.

The members of the present family live in most cases as commensals on various species of Crustacea.

Genus TRITICELLA, *Dalyell*.

Der. Dim. of *triticum*, wheat; named from its resemblance to a grain of wheat.

TRITICELLA, Dalyell (1848), Rem. An. Scotl.: G. O. Sars.

FARRELLA (part), Alder.

GENERIC CHARACTER. STEM *repent*. ZOECIA *with a membranous area on one side (the ventral), flat or slightly depressed; more or less gibbous on the other (the dorsal*)*; compressed laterally, attached by a movable joint to a rigid peduncle. POLYPIDE *without a gizzard*.

THIS is the only British Polyzoon in which the zoecia are movable, with the exception of *Mimosella*, the sessile cells of which sway backwards and forwards as the polypide issues or retreats. In *Triticella* the cell is attached by an elastic joint to the summit of the stalk, and is capable of being moved about to a certain extent at the will of the animal. According to an observation of Sir Philip Egerton's, in *Hippuraria* it can be bent, so as to form a right angle with the peduncle.

In a species belonging to the present family (*Lagenella nutans*), and probably referable to *Hippuraria*, Joliet has observed two groups of muscles, attached on the one hand to the walls of the zoecium, and on the other to

* "Instead of the regular cylindrical or ovate shape (of cell) which distinguishes all known *Vesiculariidae* (including *Cylindraciidae*), we meet here universally in fully developed zoecia with a very characteristic bilateral formation, so that we can distinguish, as amongst the *Cheilostomata*, a back and front side, or, more correctly, a ventral and dorsal side, which in form and structure are essentially different from one another. . . . The ventral side is that immediately within which, when the polypide is retracted, the tentacular wreath with the lophophore is placed; the dorsal side is that near which the alimentary canal with the anal opening lies, and immediately within which the sexual elements are developed."—G. O. SARS.

the peduncle, which by their contractions produce very remarkable nodding movements in the cell*.

Some of the species are furnished with a semicircular chitinous band or rib, which passes upward from the dorsal surface on each side towards the aperture, and may serve to strengthen the wall of the cell. Sars has named it *frenaculum*. I have not included the character in the generic diagnosis, as it does not seem to have any special significance, and is wanting in a form which in all the most important points agrees with *Triticella*.

Dalyell was the first (1858) to describe a member of the present genus; but his brief account of *Triticella flava* gives no true idea of its structure. The peculiarities of the generic type were really unknown until the publication (in 1873) of a most able paper by G. O. Sars, on certain Scandinavian species of *Triticella*, in which he has fully demonstrated its structure and discussed its affinities and systematic position†.

TRITICELLA FLAVA, Dalyell.

Plate LXXX. fig. 7.

TRITICELLA FLAVA, *Daly.* Rem. An. ii. 66, pl. xix. fig. 1: *G. O. Sars*, Christian. Vidensk. Selsk. Förhand. 1873, 398.

Zoæcia of a faint yellowish colour, short ovate (viewed laterally), the dorsal surface curved outwards; peduncle very short, about half the length of the cell.

Polypide with 20 tentacles.

* 'Bryozoaires des côtes de France,' p. 101.

† "Om en hidtil lidet kjendt mærkelig Slægstype af Polyzoer," af G. O. Sars.

DALYELL's description of *T. flava* is not sufficiently minute, nor his figure sufficiently trustworthy in details, to enable us to form a satisfactory judgment as to the form which he had in view. Mr. Norman, who has obtained the *T. Korenii* of G. O. Sars in Scotland, is of opinion that it is identical with the present species. He considers the length of the peduncle comparatively unimportant as a specific character; whilst the fact that all the Scottish specimens were attached to the same kind of Cirriped affords a presumption that they are referable to the same species. On the other hand, it may be said that the habitat cannot certainly be accounted conclusive evidence of identity, and that (though there may be considerable diversities in the length of the peduncle within the same colony) the fact that in a large group of *T. flava* (containing thirty or forty cells), as stated by Sir J. Dalyell, the peduncle was always only about half as long as the cell, and the *maximum* length therefore much less than in *T. Korenii*, may possibly indicate a difference of species.

I would not be understood as giving any decided opinion on the point; but under all the circumstances it seems better to keep the forms apart and retain the two names, if only to challenge further investigation.

Dalyell says that "the cell is apparently somewhat of membranaceous texture; it becomes distorted, and it stands awry on its pedicle. . . . The form of the cell bears some resemblance to a grain of wheat."

HABITAT. On *Sacculina carcini* (a Cirriped parasitic on the common shore-crab, *Carcinus mænas*).

LOCALITY. Scotland (Dalyell).

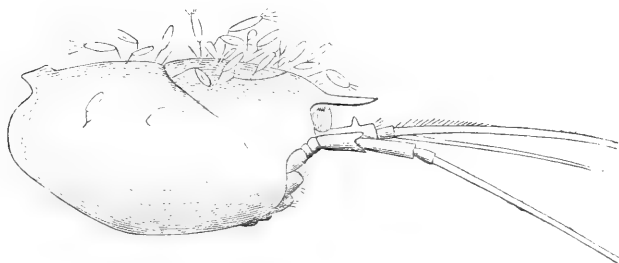
TRITICELLA KORENII, G. O. Sars.

Plate XLV. figs. 8-10 (omitted in the description of the Plates. Fig. 10, a young cell); Plate LXXX. fig. 6; and Woodcut, fig. 31.

TRITICELLA KORENII, G. O. Sars, Christian. Vidensk.-Selsk. Förh. 1873, 393, pl. ix.

TRITICELLA FLAVA, Norman, Ann. N. H. February 1879, 138.

Fig. 31.

Colony of *Triticella Korenii*, nat. size.

Zoæcia hyaline, scattered on a delicate creeping stem, slender, elongate-ovate, slightly curved outwards on the dorsal side, except at the very base, where the outline is somewhat incurved, the chief convexity being below the centre of the cell; the ventral or front side occupied in great part by a produced elliptical area, which is slightly depressed and covered in by a very delicate membrane. *Frenaculum* (or horny band) very much attenuated, placed at a short distance (about one fifth the length of the cell) above the base. *Peduncle* of very variable length, usually as long as the cell or longer.

Polypide with about 18 tentacles, which nearly equal the cell in height.

THIS species is characterized by its tall and very slender

cell, the dorsal outline of which (when viewed sideways) is very slightly curved outwards, and presents no abrupt convexity at any part. The opposite or front side, from the lower extremity of the area (where there is usually more or less of an angular projection) upwards, is somewhat flattened. When viewed in front, the cell presents a very regular figure, attenuated below, slightly enlarged towards the centre, and above it narrowing off very gradually towards the truncate top. From *T. Boeckii*, Sars, the present species differs in the more regular shape and slenderer proportions of the zoæcium, and in the size and position of the frenaculum, which is placed much nearer the base of the cell than in the first named. On the average, too, the peduncle seems to be much longer in *T. Boeckii* than in *T. Korenii*; but there is much variability in this character. The frenaculum in this species is very inconspicuous, and may readily escape observation.

As *T. Boeckii* may probably occur on our coasts, an outline of its cell is given, taken from one of Sars's excellent figures (wood-cut, fig. 32).

HABITAT. On various Crustacea, from tide-marks to very deep water.

LOCALITY. Shore of Kerrera Sound, near Oban, on *Sacculina carcini* (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Near Bergen, in 120 fathoms, on the carapace of *Calocaris Macandrei*, Bell; Bohuslän, on the same (G. O. Sars).

Fig. 32.



Triticella Boeckii,
Sars.

TRITICELLA PEDICELLATA, Alder.

Plate LXXX. figs. 3-5.

FARRELLA PEDICELLATA, Alder, N. Cat. loc. cit. 68, pl. vi. figs. 1-3; Quart. Journ. Micr. Sc. v. 24, pl. xiv. figs. 1-3.

Zoecia ovate-oblong, transparent, scattered along a delicate creeping stolon; the dorsal side (viewed laterally) very slightly curved outwards, the front side occupied almost entirely by the membranous area, which extends nearly to the bottom of the cell. The *zoecium* (viewed in front) slightly contracted at the base, but of about equal width for a great proportion of its length, scarcely narrowed towards the top; no angular projection at the lower extremity of the area. *Frenaculum* wanting. *Peduncle* very slender, usually two or three times the length of the cell.

Polypide with 12 tentacles.

Length of cell $\frac{1}{30}$ inch.

THIS is a much smaller species than the preceding, with a very regularly shaped cell; though destitute of the *frenaculum*, it exhibits all the more important structural peculiarities of the genus *Triticella*.

"The animal, as seen through the transparent cell-walls, is of a pale yellow colour, with a brownish-red patch indicating the position of the stomach. The ovaries are white. The base of the cell is finely wrinkled, and at its junction with the pedicle it forms a kind of joint, which can be more or less twisted at the will of the animal."

—ALDER.

HABITAT. On old shells from deep water.

LOCALITY. Northumberland, on *Buccinum undatum* and *Fusus antiquus* (Alder).

Genus HIPPURARIA, Busk.

Der. From ἵππος, a horse, and οὐρά, a tail.

HIPPURARIA, Busk, Proc. Zool. Soc. Lond. 1874.

LAGENELLA (part.), Joliet.

GENERIC CHARACTER.—STEM *repent or erect, tubular, jointed, nodular*. ZOÆCIA *with a membranous area on the front or ventral side, attached to a peduncle by a movable joint, and disposed in whorls or groups at the nodes*.

THE generic character is framed to include the form described by Joliet under the name of *Lagenella nutans**, which has a creeping nodular stem, on which the zoæcia are placed in groups at the nodes, instead of being disposed round an erect stem in whorls, as in the species characterized by Busk. The recent observations of G. O. Sars on *Triticella* enable us to interpret this remarkable form, and throw light on several points in its structure, which Mr. Busk, having only a single, imperfectly preserved specimen before him, was unable to determine.

Hippuraria appears to be a clustered *Triticella*. Its cell seems in most respects to resemble so exactly that of the latter genus, that we are perhaps warranted in supposing that the appearances which led Mr. Busk to describe it as composed of two distinct compartments may have been due to the condition of his specimen. If the zoæcium of *Hippuraria* is indeed two-chambered, this character will make it the type of a separate family.

* This species occurs on *Vesicularia spinosa* and the leaves of *Nitophyllum*.

HIPPURARIA EGERTONI, Busk.

Plate LXXVIII. figs. 1-4.

HIPPURARIA EGERTONI, *Busk*, Proc. Zool. Soc. Lond. for Jan. 6, 1874, 29, pl. v.

Stem erect, obscurely jointed, with nodular enlargements at nearly equal distances apart. *Zoæcia* attached by a movable joint to long, slender, transparent peduncles, which are clustered at the nodes, springing from all sides of the stem, pyriform, attenuated at the base and widening upwards to the top, where they are about three times as broad as below, the dorsal side somewhat gibbous, on the front (or ventral) side a broadly elliptical area, occupying about two thirds of its whole extent, with a membranous covering. ? *Frenaculum*.

Height of cell and peduncle about $\frac{1}{8}$ inch.

WE must wait for a more satisfactory account of this interesting species until its rediscovery may give the opportunity of making a thorough study of its structure. The fragment on which Busk's description is founded was about a quarter of an inch in length; it had been dried and reexpanded, and was, of course, in a very unfavourable state for examination. The sketch of the Polyzoon when alive, by Sir P. Egerton (Plate LXXVIII. fig. 3), shows the extent to which the cell can be bent upon its peduncle.

HABITAT. On the carapace of Crustacea.

LOCALITY. Berehaven, Ireland, on *Gonoplax angulatus* (Sir Philip Egerton).

Fig. 33.

*Valkeria ura.*

ii. CAMPYLONEMIDA, Hincks.

Tentacles not forming a perfect circle, two of the number being always everted.

THROUGHOUT this group the polypide is of the simplest structure and of very delicate habit, and in all cases it exhibits the curious arrangement of the tentacles which has suggested the name. Two of the number are universally bent outwards towards the side, so that the tentacular wreath does not form a perfect circle; the remaining six stand erect, in the usual way. I believe that the two everted tentacles are always placed on the same side as the anal opening. The number of tentacles is constantly eight; a gizzard is always wanting.

The remarkable modification of the tentacular wreath must be regarded as an important character, and as affording a very sure indication of natural affinity.

Family VIII.—Valkeriidæ.

VESICULARIADÆ (part.), Johnston : Alder.

VESICULARINA (part.), Landsborough.

ZOECIA contracted below, deciduous, destitute of a membranous area.

Genus VALKERIA (part.), Fleming.

Der. Named in honour of Dr. Walker, Professor of Natural History in the University of Edinburgh.

VALKERIA (part.), Fleming, Mem. Werner. Soc. (1823); Br. An. : Farre :
Van Beneden : Johnston : &c.

SERTULARIA (part.), Linnæus : Pallas, &c.

CLYTIA (part.), Lamouroux.

VESICULARIA (part.), J. V. Thompson : Smitt.

CUSCUTARIA, Blainville.

CAMPYLONEMA, Hincks, Ann. N. H. 1872 (for *V. tremula*).

GENERIC CHARACTER.—ZOARIUM *erect or repent*. Zo-
ECIA *ovate, clustered*. POLYPIDE *destitute of a gizzard*.

VALKERIA UVA, Linnæus.

Plate LXXV. figs. 1-5, and Woodcut, fig. 33.

Repent form. GRAPE CORALLINE, Ellis, Corall. 27, no. 25, pl. xv. fig. c, C, D.

SERTULARIA UVA, Linnæus, Syst. ed. 12, 1311 : Ellis & Sol. Zooph. 53.

CLYTIA UVA, Lamx. Pol. cor. flex. 203.

VALKERIA UVA, Flem. B. A. 551 : Johnst. B. Z. ed. 2, 375 : Couch, Corn.

Faun. iii. 95, pl. xvi. fig. 5 : Alder, North. Cat. 67 (sep.), &c.

(not *Vesicularia uva*, Smitt, Krit. Fört. pl. xiii. figs. 29-33).

CAMPANULARIA OVIFERA, Blainv. Actinol. 473.

Erect form. CLIMBING DODDER-LIKE CORALLINE, Ellis, Corall. 28, no. 26,
pl. xiv. fig. c, C.

SERTULARIA CUSCUTA, Linn. Syst. ed. 12, 1311 : Pall. Elench. 125 : Ellis &

Sol. Zooph. 53 : Abildgaard, Zool. Dan. iii. 62, pl. cxvii.

figs. 1-3 : Lamx. Pol. cor. flex. 198 : Flem. Mem. Wern.

Soc. iv. 485, pl. xv. fig. 1.

VALKERIA CUSCUTA, *Flem. B. A.* 550: *Farre*, *Phil. Trans.* 1837, 402, pl. xxiii.: *Van Ben.* 'Recherches' (1845), 27, pl. iv. fig. B (*Mém. Brux.* xviii. 3, pl. i.): *Johnst. B. Z.* ed. 2, 374: *Dalyell*, *Rem. An.* i. 248, pl. li. figs. 1, 2: *Landsb.* *Pop. Hist.* 370, pl. xx. fig. 78: *Smitt*, *Cefv. &c.* 1866, 501 & 523, pl. iii. figs. 28, 34, 35: *Joliet* (including both forms), *Bryoz. d. côtes d. France*, 101.

NIGELLASTRUM CUSCUTUM, *Oken*, *Lehrb. Naturg. Zool.* pt. ii. 93.

VESICULARIA CUSCUTA, *J. V. Thomps.* *Zool. Illustr.* 97, pl. ii. figs. 1-4.

CUSCUTARIA CUSCUTA, *Blainv.* *Actinol.* 497, pl. lxxxii. fig. 2.

Stem repent and adnate, jointed at intervals, giving off branches in opposite pairs, also adnate (form *uva*); or sending up free, slender, flexile shoots of varying length, much attenuated towards the extremities, and bearing opposite branches (form *cuscuta*). *Zoœcia* small, slender-ovate, transparent, clustered about the joints, chiefly on the lateral branches.

Polypide with 8 tentacles.

Height of the erect form (*cuscuta*) about 2 inches; occasionally 4.

THE only difference between the Linnaean species *Sertularia uva* and *S. cuscuta* seems to lie in the habit of growth. The latter is an erect and luxuriant variety of the former.

In its repent condition *V. uva* is a very minute and inconspicuous species (though a singularly beautiful object when living); the variety *cuscuta*, on the contrary, is free and vigorous in its growth, and forms clustering masses of tall wavy shoots. The groups of cells placed at the origin of the branches, and scattered at intervals along them, give it a very pretty and characteristic appearance.

The branches are always given off immediately below a joint, where the stem is somewhat dilated; the cells are borne principally on the branches; and in some cases a large number of very short internodes occur above the point of origin, on which they are thickly clustered (Plate LXXV. fig. 2).

The polypide affords a good illustration of the Campylonemidan structure (woodcut, fig. 33). It is interesting to watch it issuing from its cell; at such a time the peculiarity in the tentacular wreath is very apparent. When the pencil of tentacles is rising, as soon as it has reached a certain point the two bent arms spring out, one at each side, the rest continuing straight and folded together until the whole bell expands. *V. uva*, especially in its humbler form, is one of the commonest of our littoral species, and may be readily obtained on the *Corallina* in rock-pools, over which it creeps in great abundance.

HABITAT. On various *Fuci*, *Corallina*, *Sertularia pumila*, &c., and occasionally on shells, between tide-marks and in shallow water; rarely in deep water (form *cuscuta*).

LOCALITIES. Form *uva*. Widely distributed. Cornwall (Couch): Guernsey and Jersey; South Devon; Ilfracombe; Menai Straits, on the larger *Fuci*, in immense quantity (T. H.): Northumberland (Alder): Leith (Jameson): coasts of Antrim and Down (W. T.): Dublin Bay (Hassall): Belfast Bay, 20 fathoms, on *Flustra foliacea* (Hyndman), &c.

Form *cuscuta*. Isle of Sheppey (Farre): Firth of Tay, in brackish water (Fleming): Leith (Jameson): Ayrshire (Landsb.): Peterhead, very rare; Wick, deep water; Norfolk; Cornwall (C. W. P.): Isle of Wight (W. T.): Guernsey (R. S. Cooper): Mount's Bay; Exmouth; Torquay, in rock-pools on *Corallina*; Plymouth, of remarkable size; Llandudno; Menai Straits, on the larger *Fuci*; Filey; Oban (T. H.): Tenby (F. Walker): Shetland (A. M. N.): Dublin Bay (Miss Ball): co. Sligo (Mrs. Hancock): Magilligan (Hyndman): Belfast and Strangford Loughs (W. T.).

GEOGRAPHICAL DISTRIBUTION. Baltic (Müller) : Belgium (Van Ben.) : Bahusia, 5–10 fathoms (Smitt) : Kattegat (Kirchenpauer) : Roscoff (Joliet)*.

VALKERIA TREMULA, Hincks.

Plate LXXX. figs. 1, 2.

VALKERIA TREMULA, *Hincks*, Dev. Cat., Ann. N. H. ser. 3, ix. (1862), 472, pl. xii. fig. 9.

CAMPYLONEMA TREMULUM, *id.* Ann. N. H. ser. 4, x. (1872), 396, pl. xx. fig. 5.

Stem filiform, creeping. *Zoæcia* distributed upon it at intervals in groups, very small and slender, elongate, slightly narrowed above, and below tapering off to a point.

Polypide with 8 tentacles.

THIS species is distinguished by its extreme minuteness and its tapering cells, which are attenuated downwards from the middle and terminate in a point. They are very slightly attached: when the polypide is retracted they droop a little to one side, and rise into an erect position when it expands.

The polypides are extremely minute and very nimble in their habits; those of *Valkeria uva* appear coarse and clumsy beside them.

This is the first species in which I observed the peculiar arrangement of the tentacles, and the genus *Campylonema* was founded for its reception. But as it now appears that *V. cuscuta*, the type of Fleming's genus *Valkeria*,

* Joliet records both the creeping form and the erect—"dont les filaments flottant librement dans l'eau atteignaient jusqu'à 6 et 8 centimètres de longueur,"—and remarks that it is impossible to distinguish the two specifically.

exhibits the same structure, his name, of course, has precedence.

HABITAT. On stones and stems of Algæ between tide-marks, and on shell from moderately deep water.

LOCALITIES. Salcombe Bay, on *Flustra papyracea*; Ilfracombe, on the Capstone, not uncommon; dredged off the Isle of Man (T. H.)

Family IX.—Mimosellidæ.

ZOECIA *contracted below, movable, deciduous, with an aperture on the ventral side.*

Genus MIMOSELLA, *Hincks.*

Der. Dim. of *Mimosa*, the Sensitive Plant.

MIMOSELLA, Hincks, Ann. N. H. 1851: Landsborough: Heller: &c.

GENERIC CHARACTER.—ZOARIUM *phytoid, regularly jointed, consisting of a creeping tubular base and erect shoots, much and irregularly branched, branches opposite. ZOECIA ovate, biserial, opposite, attached to the sides of the stem by a basal joint, by means of which they can be moved to and fro and folded together. POLYPIDES with a small number of tentacles; without a gizzard.*

MIMOSELLA is separated from the *Valkeriidæ* by its movable cells, and more especially by the large aperture on the ventral aspect of the zoecium. The latter occupies almost the whole of the front side, extending from the top nearly to the base of the cell. It is closed by a thin membranous covering, and, when the polypide is retracted, is very inconspicuous and may most readily escape obser-

vation. When the polypide, however, issues from its dwelling, the membranous wall is drawn inwards, a depression or cleft is distinctly visible, and the cell appears distorted; the solid part is somewhat boat-shaped, forming a kind of shield.

I have not been able to detect any special arrangement of muscles connected with the remarkable movements of the zoœcia; and from their character, and the fact that they are coincident with the expansion and retraction of the polypide, I should certainly regard them as dependent on these changes, were it not that I have, on more than one occasion, seen cells from which the polypide had disappeared move backwards and forwards.

The folded cells open slowly; and there is an occasional pause before they are thrown fully back. They begin to close (as it seems) not when the polypide merely retreats, but when it draws itself down to the very bottom of its cell. Then they instantly begin to fold up, moving slowly at first, but, when they have fairly swung round to the front side of the stem, closing rapidly with a kind of jerk. A hollow at the base of the cells fits over a tubular projection on the stem; and upon this they sway backwards and forwards.

The polypide is small, with a short and slender stomach, and is destitute of a gizzard.

MIMOSELLA GRACILIS, Hincks.

Plate LXXIV. figs. 1-6, and Woodcuts, figs. 27 & 34.

MIMOSELLA GRACILIS, *Hincks*, Ann. N. H. ser. 2, viii. 359, pl. xiv. figs. 5-8; xi. 184; Dev. Cat., Ann. N. H. ser. 3, ix. 472 (58, sep.), pl. xvi. fig. 1: *Heller*, Bryoz. Ad. M. 52, pl. vi. figs. 1, 2.

VALKERIA CUSCUTA, *Couch*, Corn. Faun. iii. 96, pl. xvii. fig. 3.

Zoarium erect, confervoid, of a light horn-colour, consisting of slender, jointed, tapering stems, much and ir-

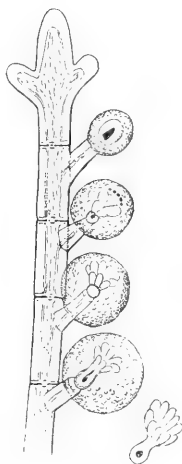
regularly branched, which rise from a mass of ramified and interlacing tubes; the branches opposite, either short and simple pinnæ, or elongate tapering shoots pinnate or bipinnate, the pinnæ divided by joints into very short internodes, each of which supports a pair of cells. *Zoæcia* ovate, biserial, opposite, borne chiefly on the pinnæ and rarely on the principal stems, folded together when the polypides are retracted, but thrown back and standing out from the side of the pinna when they expand.

Polypide with 8 tentacles.

THIS beautiful species is a very free grower, and forms large intricate masses, which hang in festoons about the stems of the *Halidrys*, on which it is always found. The ramification is irregular and luxuriant; the tall flexile stems, which are much attenuated towards the extremity and run out into filamentary, tendril-like prolongations, are thickly set, now with short pinnæ, now with long, slender, tapering branches either pinnate or bi- and tripinnate. Not unfrequently these are replaced by longer shoots, much and variously branched, which are copies of the principal stems. The pinnæ or branches originate immediately below a joint and tend upwards, so as to form with the stem an acute angle; the pairs very frequently spring from different aspects of the shoot.

Towards the base of the pinnæ the zoæcia are tall and oval; as they approach the apex they become short and globose, and at last are nothing more than little round excrescences.

Fig. 34.



Upper portion of pinna.

When the cells are all folded together, just as the leaflets close on the leaf of the Sensitive Plant, they appear (on slight inspection) as if they were unilateral in their arrangement. Generally, however, in the living specimen, one or two cells at least on a pinna are thrown back; and when the polyzoon is healthy and vigorous, there is a constant folding and unfolding of the pinnules, as the polypides issue and retreat.

I first dredged *Mimosella gracilis* under the rocky shores of Salcombe Bay; it appears to be common wherever *Halidrys siliquosa* abounds along our south-western coasts. Devonshire specimens are preserved in Dr. Johnston's collection, ranked under *Valkeria cuscuta*, with which it was also confounded by Couch, who had obtained it in Cornwall.

HABITAT. In the Laminarian zone, on *Halidrys siliquosa*.

LOCALITIES. Salcombe Bay, abundant; Torbay, in shallow water, under Berry Head, and east in plentifully in autumn on Meadfoot beach, after strong south-easterly winds (T. H.): Plymouth Sound (Templar): Polperro and Goran (Couch): Penzance (C. W. P.): Guernsey (R. S. Cooper).

GEOGRAPHICAL DISTRIBUTION. Adriatic (Heller): La Spezzia (Reichert).

Family X.—Victorellidæ.

HOMODLETIDE, W. Saville Kent, Quart. Journ. Micr. Sc.

ZOECIA originating in an enlargement of the creeping tubular stem, with which they are continuous at the base; above free and cylindrical; not deciduous.

THE present family was first defined by Mr. Saville Kent,

who clearly pointed out the important difference in the structure of the zoëcium, which separates it from the *Vesiculariidae*. I have not adopted his name for it (*Homodiatidae*), because throughout this work the family designations have been derived from typical genera, and it seems desirable to preserve uniformity of practice.

Genus VICTORELLA, *Saville Kent*.

Der. Named after the Victoria Dock, London, in which it was first discovered.

VICTORELLA, W. Saville Kent, Quart. Journ. Micr. Sc. 1870.

GENERIC CHARACTER.—ZOARIUM *consisting of a creeping ramified stem, which swells out at intervals into somewhat fusiform or clavate enlargements, in which the cells originate. ZOECIA decumbent at the base, which is continuous with the stem, above free and cylindrical; branches given off from the sides of the expansions in the course of the stem. POLYPIDES with few tentacles; no gizzard.*

IN the character of the zoëcium *Victorella* agrees with the *Cylindræciidae*; but from this group it is separated by the structure of the polypide, which is of the Campylonemidan type. It is a simple and primitive form, as shown by the imperfect differentiation of the cell; and, from the extreme transparency of the ectocyst, which interposes no difficulty in the way of observation, it would afford the best opportunities for the study of the structure and functions of the endosarc, and of many other interesting problems.

In an early stage of development the cell consists wholly of the stolonian expansion, within which the formation of the polypide proceeds up to a certain point. The erect tube is an after-growth (Plate LXXIX. fig. 7). I have

only seen a few mounted cells (which I owe to Mr. Kent's kindness), and have therefore had no opportunity of making a minute study of the structure. But a few points it has been possible to determine.

The endosarcial cord which pervades the stolon dilates as it enters the cell-like expansion, and takes the form of a plexus-like tissue, which partially fills the cavity, and within which the polypide is developed. The expanded and more or less ovate portion of the stolon is closed above by a diaphragm, beyond which the stem is continued. At its upper end, and immediately below the diaphragm, a tubular projection rises in front, which is the rudiment of the erect portion of the adult cell. At this stage (as represented in Plate LXXIX. fig. 7) the forming polypide consists of an ovate body, prolonged and attenuated below, where it seems to be doubled upon itself, and above continued into a kind of neck, which reaches to the top of the tubular projection. The later course of the development I have not been able to follow; but the polypide must increase greatly in size to fill, as it does, the erect tube into which it is ultimately withdrawn.

These fragments of the developmental history of *Victorella* give the following results:—

1. They confirm Joliet's views respecting the formation of the polypide out of the endosarc.

2. They suggest very forcibly the homology between the zoæcium and the stolonian internodes amongst the *Ctenostomata*.

3. They indicate the primitive condition of the zoæcium, and give us a clue to the meaning of the stolonian expansions in such a form as *Aetæa*, and to the mode in which the tube may have been gradually superadded in the latter to a simple hippothooid cell.

VICTORELLA PAVIDA, Saville Kent.

Plate LXXIX. figs. 4-7.

VICTORELLA PAVIDA, Kent, Quart. Journ. Micr. Sc. (n. s.), x. 34, pl. iv.

Stem repent, very slender and transparent, the clavate enlargements usually wide apart. *Zoëcia* with the upper portion erect, cylindrical, tall, slender, perfectly transparent, below adherent and dilated; branches given off at each side of the expanded base, near the origin of the erect tubular portion of the cell.

Polypide with 8 long and remarkably flexible tentacles, two of which are everted.

THIS is an extremely minute species, and has hitherto only been taken in brackish water amongst a prevailingly fluviatile fauna. *Bowerbankia imbricata* was obtained in the same locality.

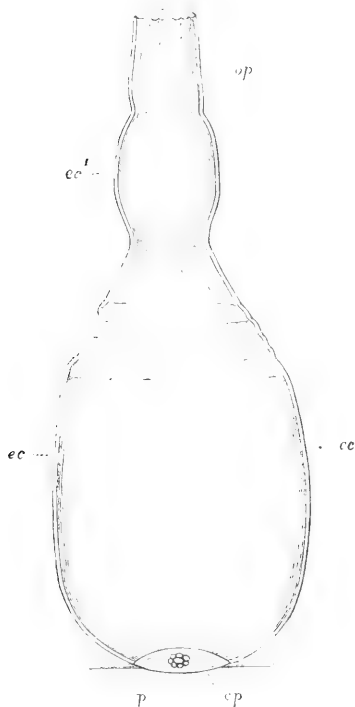
The zoëcial tubes vary in height, but are usually tall, and very slender; they are generally placed at very considerable distances from each other. The stolon widens out at intervals into cell-like expansions, of which the erect tubes are a direct continuation, rising immediately out of them, so that they constitute an integral part of the zoëcium. Just above the cell there is a joint; and in most cases (but not, I think, universally) there is also one at the point where the expansion narrows into the stem. The ramification is simple and uniform; on each side of the enlargement, near the base of the erect tube, a single branch is given off, a joint always occurring at the point of origin; and after a longer or shorter interval the branch, like the main line of the stolon, dilates into a cell.

The zoëcium terminates above in a remarkably tall pencil of setæ.

HABITAT. On *Cordylophora lacustris* in brackish water, chiefly at a depth of some 5 or 6 feet below the surface.

LOCALITY. Victoria Dock, London (W. S. Kent).

Fig. 35.



The Ctenostome cell (after Reichert).

ec. Ectocyst, forming the solid portion of the cell-wall. *ec¹.* The flexible portion of the ectocyst. *op.* The setose operculum. *cp.* The communication-plate or septum. *p.* Pores, for the passage of the endosarc.

Subclass HOLOBRANCHIA, E. Ray Lankester.

Group *b*. *ENTOPROCTA*, Nitsche.

POLYZOA *having both the orifices of the alimentary canal within the lophophore; tentacular sheath wanting; tentacles bilaterally disposed, not retractile; no perivisceral cavity* *.

Order PEDICELLINEA.

The only order.

Family I.—**Pedicellinidæ.**

POLYPIARIA PEDICELLINEA, P. Gervais (1837).

PEDICELLINE, Johnston.

POLYPIDES *borne on a retractile peduncle, united in colonies by a creeping stolon.*

WE owe the separation of the *Entoprocta* from the rest of the Polyzoa as a distinct group to the able German biologist, Nitsche (Zeitsch. wiss. Zool. xx. 1 Heft).

The chief structural peculiarity which distinguishes them is the position of both the orifices of the alimentary canal within the tentacular wreath; amongst the ordinary Polyzoa (*Ectoprocta*) the mouth only is surrounded by the tentacles. But associated with this important

* Amongst the *Entoprocta* there is no true body-cavity containing a perigastric fluid, as in most other Polyzoa. Such small space as there is between the inner wall of the zoecium and the alimentary canal is occupied by a more or less solid parenchymatous tissue.

and cardinal character are others which, though secondary, are of great interest and systematic value. The tentacles are not attached to a retractile portion of the cell; there is no invagination of the anterior region, and consequently no tentacular sheath. The arms originate from the upper margin of the cup-like body, and are bilaterally disposed; they are not withdrawn into the cavity of the cell, but merely rolled up, when at rest, and in this condition are partially within the vestibule which occupies the upper portion of the body. The integument of the body (equivalent to the zoœcium) is comparatively soft, and is never strengthened by calcareous material; it immediately incloses the alimentary canal; and there is therefore no perivisceral space, like that by which the polypide is surrounded in the ordinary Polyzoa. The polypide of the *Entoprocta* is incapable of the lively movements which are so characteristic of the latter: it is fixed in its cell; and the system of muscles concerned in the acts of protrusion and retraction, which attains so high a development in other sections of the class, is wanting. The *Pedicellinidæ* are all furnished with a contractile stem, on the free extremity of which the body is placed; and this peculiarity distinguishes them in a very marked way from the rest of the Polyzoa.

Genus PEDICELLINA, Sars.

Der. From *pes*, a foot.

PEDICELLINA, Sars, *Beskrivelser* &c. (1835): Johnston: Van Beneden: Nitsche: Smitt: &c.
 HYDRA (part.), Bosc: Blainville: &c.
 CRINOMORPHA, Van Beneden (1844).

GENERIC CHARACTER.—POLYPIDES *pedunculate, distri-*

buted along a creeping, ramified stolon; the body separated by a diaphragm from the stem, and deciduous; tentacular crown terminal.

PEDICELLINA CERNUA, Pallas.

Plate LXXXI. figs. 1-3; and Woodcut figs. 36, 39.

? "FLESHY POLYPES OF A RED COLOUR AND A PARTICULAR KIND," *Ellis*,
Corall. pl. xxxviii. figs. 5, 6, E, F.

BRACHIONUS CERNUS, *Pallas*, Naturges. merkwürd. Thiere (1771), Samml.
10, 57, pl. iv. fig. 10.

? HYDRA LUTEA, *Bosc**, Hist. Nat. des Vers (1802) ii. 236, pl. xxii. fig. 2 :
Lamk. An. s. V. ed. 2, ii. 71 : *Blainv.* Dict. Sc. Nat. lx.
459.

HYDRA CORONATA, *Flem.* B. A. 554.

PEDICELLINA ECHINATA, *Sars*, Beskr. og Iakttag. &c. (1835), 5, pl. i. figs. 1,
a-f: *Hassall*, Ann. N. H. ser. 1, vii. 365: *Reid*, Ann. N.
H. xvi. 390, pl. xii. figs. 8, 9: *Johnst.* B. Z. ed. 2, 382,
pl. lxx. fig. 5: *Smitt*, Œfv. Vet.-Ak. Förh. 1867, 458:
Nitsche, Zeitsch. f. wiss. Zool. xx. 13, pl. ii.: *Barrois*,
Embryol. d. Bryoz. 27, pl. ii.: *Joliet* (forma *typica* and
var. *glabra*), Bryoz. &c. 103, &c.

PEDICELLINA CERNUA, *Smitt* (forma *cernua* and forma *nutans*), Œfv. &c.
1871, 1132.

PEDICELLINA BELGICA, *Gosse*, Dev. Coast, 210, pl. xii. figs. 2-4 (var. with-
out spines): *Hincks*, Ann. N. H. ser. 2, viii. 360 (the
same).

Polypides borne on a flexuous, transparent stolon, more or
less branched; often densely clustered. *Body* whitish,
cup-shaped, somewhat compressed laterally, usually very
ventricose on one side (the dorsal or anal), and sub-
truncate on the opposite; tentacles 14-24. *Peduncle*
stout, tapering slightly towards the top, and covered
with short obtuse spines.

Var. *a* (*glabra*). With the peduncle smooth.

* It must be held doubtful whether *Bosc's* species is identical with the
present. His figure is of no value; he makes no mention of spines on the
stem, and describes the whole zoarium as being of a sulphur colour. His
specimens were attached to *Fucus nutans*.

THE form of the body is liable to some variation, apart from the changes which are due to the different degrees of contraction. It is occasionally much elongated (Plate LXXXI. fig. 2) ; but commonly it is rather short, very gibbous on one side, and almost straight on the other. In one marked variety the peduncle is quite destitute of spines ; but normally they are present in great numbers, and sometimes are also scattered sparsely over the body*.

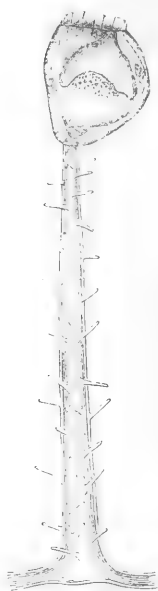
The movements of the peduncle are vigorous and lively : the polypides, when excited, dash themselves vehemently from side to side ; and one striking against another, the commotion spreads throughout the colony until "the effect is that of a field of corn swept by a strong breeze" †.

The body, which is separated from the stem by a distinct diaphragm, is deciduous ; it falls, and after a time is renewed by a process of gemmation, the headless stalk retaining its muscular activity.

The larvæ, according to Joliet, are produced throughout the summer, from May to September, but especially in May and June.

It is with extreme reluctance that I have abandoned Sars's familiar name for this species ; but, according to the ordinary laws of nomenclature, there can be no doubt

Fig. 36.

*Pedicellina cernua.*

* Joliet states that he has often found amongst a group of polypides with smooth peduncles an individual furnished with spines, and that in some cases these appendages occur only on a section of the length of the stem or on one of its sides.

† Van Beneden.

that Pallas, who described and figured it nearly sixty years before the Norwegian zoologist wrote, is entitled to precedence. His description of the external form is very accurate and quite sufficient for identification. He mentions the soft, cup-shaped body with its tentacles, the hairy or spinous stem, and the common, branched stolon. His figure is a very fair one of its class. He regarded it as one of the "Seeaster-polypen," referable to *Brachionus* or *Vorticella*. It is curious that Sars considered that there was considerable affinity between *Pedicellina* and the last-named form, and that it was a link between this tribe of Infusoria and the Polypes ('Beskrivelser' &c. p. 4).

Pallas's work in which the description of *Brachionus cernuus* appeared was published at Berlin in 1771.

HABITAT. On zoophytes, Algæ, shells, &c., between tide-marks and in shallow water.

LOCALITIES. Common and widely distributed.

GEOGRAPHICAL DISTRIBUTION. Roscoff, dredged on *Vesicularia*, and on *Antennularia* and other Hydroids, common; also on *Bugulæ* at extreme low-water; (var. *glabra*) in the littoral zone on *Corallina* &c. (Joliet): Naples (Waters): Norway (Sars): Spitzbergen, smooth var. (Smitt): Heligoland (Nitsche): White Sea, smooth var. (Mereschkowsky).

PEDICELLINA NUTANS, Dalyell.

Woodcut figs. 37, 38, 40.

PEDICELLINA NUTANS, *Dalyell*, Rem. An. ii. pl. xx. figs. 1-12.

? PEDICELLINA AMERICANA, *Leidy*, Invert. Rhode Isl. and New Jersey, Journ. Ac. N. Sc. Philadelph. ser. 2, iii. 135, pl. x. fig. 25.

Body small, vase-shaped, regular, not gibbous on the

dorsal side; tentacles 12-16 (?). *Peduncle* usually of a yellowish-red colour, tapering very decidedly towards the top, where it is much attenuated, always destitute of spines. *Stolon* distinctly jointed at intervals*.

THIS form must not be confounded with the smooth-stemmed variety of *P. cernua*. It is distinguished by the small size and regular shape of the body, which has none of the distorted appearance so characteristic of the last species, as well as by its very tapering peduncle, which is usually of an elongate-conical form. The latter character seems to be very constant: the stem tapers rapidly upwards from about the middle of its length to the point of junction with the body, terminating in a subacuminate extremity.

The ordinary height of *P. nutans* equals that of *P. cernua*; but it never reaches (in the specimens which I have examined) the somewhat gigantic proportions which the latter not unfrequently attains. The body is almost perfectly symmetrical, and is not unlike a graceful vase mounted on a pedestal; in its diminutive size it resembles that of *P. gracilis*.

This seems to be the form which Dalyell has described under the name of *P. nutans*. His figures very accurately represent its chief characteristics, and could not have been suggested by *P. cernua*, as no trace is shown of the distortion of the body. It is true that he represents his *P. nutans* as frequently erect and branched, a condition which I have not observed in the present form; but, assuming the poly-pides to be identical, this would not be a specific distinction; and it seems right therefore to retain his name.

* The stolon is much stouter than that of *P. cernua*, which is not jointed.

Fig. 37.



*Pedicellina
nutans.*

I have met with no British form agreeing with the *P. Belgica* of Van Beneden, which is characterized by the smoothness of the stem and the curious knots or enlargements at its base and in its course, and which seems to have a more regularly shaped body than *P. cernua*. The figure is accompanied by a very brief and insufficient diagnosis.

HABITAT. On Algæ.

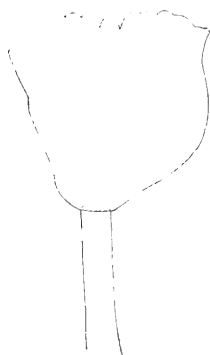
LOCALITIES. Scotland (Dalyell) : Tenby (Leipner).

Fig. 38.



Pedicellina nutans.

Fig. 39.



Pedicellina cernua *.

Fig. 40.



Pedicellina nutans *.

* These two figures are drawn to the same scale.

PEDICELLINA GRACILIS, Sars.

Plate LXXXI. figs. 4-6.

PEDICELLINA GRACILIS, Sars, Beskr. og Iagttag. 6, pl. i. fig. 2, *a*, *b*: *Johnst.* B. Z. ed. 2, 385: *Goodsir* (*Forbesia*), Ann. N. H. xv. (1845) 380, pl. xx. fig. 4: *Gosse*, Dev. Coast. 217, pl. xii. fig. 5: *Hincks*, Ann. N. H. ser. 2, viii. 360, pl. xiv. fig. 9: *Smitt* (part.), Cefv. &c. 1871, 1133: *Joliet*, Bryoz. &c. 104, &c.

Polypides scattered on a delicate creeping stolon. *Body* somewhat ovate, usually a little gibbous on one side; tentacles about 20. *Peduncle* expanded below into a short thick cylinder, above which it is extremely slender, widening slightly upwards to the point of junction with the body, destitute of spines.

THIS is a much smaller species than *P. cernua*, and may be at once recognized by the enlarged base of the peduncle. It is in this portion that the muscular power resides, to which the remarkably energetic movements of the *Pedicellinæ* are due, the part above it being a mere rigid rod supporting the body. The basal cylinder varies in length, and in the proportion it bears to the rest of the stem. Occasionally the latter is very much elongated, and consists of several sections separated by knots or swellings, which are also muscular in character.

HABITAT. On *Corallina* and *Laminaria*, Hydroida, Polyzoa (especially *Vesicularia*), &c., and under stones, between tide-marks and in shallow water.

LOCALITIES. Jersey; South Devon, common; Ilfracombe; Swanage and off Lulworth Cove; Llandudno; Aberystwith; Isle of Man; Fleetwood, on a buoy; Filey; Lamdash; Oban (T. H.): Guernsey, on *Hermione hystrix*, with *Lorosoma* (Dr. M'Intosh): Cullercoats

and Tynemouth, common (Alder): Shetland, rare (A. M. N.)

GEOGRAPHICAL DISTRIBUTION. Norway (Sars): Spitzbergen, 30 fathoms (Malmgren, *fide* Smitt): White Sea, on *Lafoea dumosa* (Mereschkowsky): Roscoff (Joliet).

Family II.—**Loxosomidæ.**

POLYPIDES borne on a contractile peduncle, solitary, always furnished in the young state with a pedal gland; gemmæ produced on the body of the polypide.

THE *Loxosomidæ* agree in all essential points with the *Pedicellinidæ*; but they are solitary animals, and this character is accompanied by certain variations in the common plan of structure. Their leading family peculiarities are all determined by this point in their history. The foot-gland for attachment, which is always present in the young, though frequently aborted in the adult, is rendered necessary by the absence of any adherent stolon. The mode of gemmation is dependent on the same circumstance*.

Curious tactile organs, placed one on each side of the body, and consisting of contractile papillæ supporting a number of delicate setæ, have been noticed in some species, and are probably always present.

* Alder records two cases in which he had observed the production of buds in *Pedicellina* from the polypide. "In one the young arose from the body of the animal, and at right angles to it; in the other from the stem a little below the body" (Suppl. to Northumb. Cat. p. 22, sep.). Barrois (in his 'Embryologie des Bryozoaires,' pl. ii. fig. 15) represents a discoid mass at the base of the peduncle in the primary polypide of *Pedicellina*, which, he conjectures, may be the rudiment of a pedal gland. We may have here memorials of the solitary ancestry of the present colonial forms.

The larva has been described, and its structure demonstrated, by Vogt and Barrois: it is essentially identical with that of the *Pedicellinidæ*, and constitutes a strongly marked type.

Genus LOXOSOMA, *Keferstein*.

Der. From λοξός, oblique, and σῶμα, body.

LOXOSOMA, Keferstein, 1863.

CYCLOPELMA, Busch, 1851 (founded on the larva).

CYCLATELLA, Van Beneden, 1864 (referred to the *Tristomidea*).

GENERIC CHARACTER.—POLYPIDES *pedunculate, solitary, the body closely united to the stem, and not deciduous; tentacular crown placed obliquely, on the ventral side of the body.*

THE unsymmetrical conformation of the body in the present genus, which shows itself in the displacement of the tentacular wreath from the summit to one side, also exists, though in a much slighter degree, in *Pedicellina*, as Vogt has remarked. There are considerable differences in the extent to which this displacement is carried amongst the species of *Loxosoma*.

The absence of the diaphragm in *Loxosoma*, which in *Pedicellina* divides the body from the stem, and which involves the frequent fall of the former, is a very marked distinction between that genus and the present. In some forms of *Loxosoma*, however, there is much more appearance of a separation between the two regions than in others, though in no case is the body deciduous.

Several species of the present genus have been discovered, ranging from the Bay of Naples to the Arctic Seas and the North-American coast. They live chiefly,

but not exclusively, as "commensals" with various species of Annelida. They have also occurred on Sponge, and on other Polyzoa (e. g. *Bugula* and *Zoobotryon*).

LOXOSOMA SINGULARE, Keferstein.

Plate LXXXI. figs. 7, 8.

LOXOSOMA SINGULARE, *Keferstein*, Zeitschrift f. wiss. Zool. xii. (1862) 13, pl. xi. fig. 29; *Claparède*, Beob. üb. An. u. entw. wirbell. Thiere an d. Küste v. Normandie, 135, pl. ii. figs. 6-10; *Barrois*, Embryol. d. Bryoz. 9 & 10, pl. i. & pl. xvi. fig. 6.

Body oval; *tentacles* 10; *peduncle* short (about half the length of the body) and stout, wrinkled transversely, terminating below in a discoid expansion, by which the polypide is attached; no pedal gland in the adult; 1-3 buds on each side.

IN the specimens examined by Keferstein only a single bud seems to have been developed on each side; but in Shetland examples, which I owe to Dr. McIntosh, as many as three are sometimes present on a side.

The short peduncle, narrowing slightly downwards, with its disk-like foot, is a character which separates this species from all its congeners.

HABITAT. On Annelids.

LOCALITY. Shetland, on *Lætmonice flicornis* (Dr. McIntosh).

GEOGRAPHICAL DISTRIBUTION. St. Vaast-la-Hougue, abundant, on *Capitella rubicunda* (Keferstein): *ibid.* on the ventral surface of *Aphrodite*, in company with *Pedicellina gracilis* &c. (Barrois).

LOXOSOMA PHASCOLOSOMATUM, Carl Vogt.

Woodcut figs. 41, 42.

LOXOSOMA PHASCOLOSOMATUM, *Vogt*, Arch. de Zool. expérimentale, v. (1877) 305, "Sur le Loxosome des Phascolosomes;" translated (by Hincks), Quart. Journ. M. Sc. (n. s.), xvii. (1877) 353, pl. xxii. : *Barrois*, Rech. sur l'embryologie d. Bryoz. (1877), 8, pl. xvi. figs. 3, 4 : *Norman*, Ann. N. H. for February 1879, 133.

STREPHENTERUS CLAVIGER (tentacular appendages of), *Norman*, Ann. N. H. ser. 3, vii. (1861) pl. ix. figs. 1-3.

Body elongate-ovate ; *tentacles* 12-18 ; *peduncle* of great length, the lower extremity "pointed like the nib of a pen ;" no pedal gland or other special organ of attachment ; buds never exceeding two.

THE long peduncle of this species is highly contractile, and its movements are very energetic ; besides bending to one side and then straightening itself, it is occasionally twisted into a spiral. In the buds the pedal gland is very distinctly visible ; but it subsequently disappears altogether. According to Vogt, it is absorbed after furnishing the secretion by which the animal is permanently fixed.

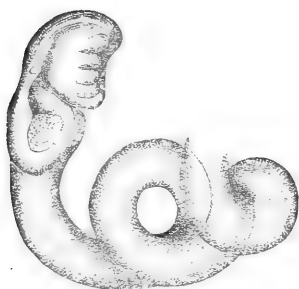
In both this and the preceding species, the oblique position of the tentacular crown on the ventral side of the body is a very marked characteristic.

Fig. 41.



*Loxosoma
phascolosomatum.*

Fig. 42.

*Loxosoma phascolosomatum.*

HABITAT. On the caudal extremity of certain Annelids (*Sipunculidea*).

LOCALITY. Bantry Bay, forming a tuft on the posterior extremity of *Phascolosoma Harveii*, Forbes (A. M. N.).

GEOGRAPHICAL DISTRIBUTION. Roscoff, abundant, on *Phascolosoma elongatum* and *P. margaritaceum* (C. Vogt; Barrois).

LOXOSOMA CLAVIFORME.

Plate LXXXI. figs. 9-12.

Body ovate ; *tentacles* (probably) 10 or 12 ; *peduncle* somewhat longer than the body, tapering off gradually downwards, and terminating below in a short, foot-like expansion,—the whole figure very regularly clavate when the tentacles are withdrawn ; ? pedal gland ; only a single bud observed, placed about halfway down the body.

THE foregoing is a very imperfect diagnosis, as the specimens examined had been long preserved in spirit, and

I was quite unable to determine with certainty either the number of the tentacles or the structure of the base of the peduncle. The form seems, however, to be distinct from the various species that have been described, so far as the somewhat meagre descriptions given of them allow us to judge.

HABITAT. On Annelids.

LOCALITY. Guernsey, abundant on *Hermione hystrix* (Dr. M'Intosh).

Subclass PTEROBRANCHIA, E. Ray Lankester.

ASPIDOPHORA, Allman, Journ. Linn. Soc. Zool. xiv. 1879.

Order PODOSTOMATA, Lankester.

Foot large, discoid, overhanging the mouth.

Family Rhabdopleuridæ.

ZOARIUM *a chitinous, adherent tube, divided by septa into compartments, from which erect tubular cells rise, in which the polypides are lodged; the whole of the adherent portions traversed by a chitinous cylindrical rod, to which the polypides are attached by means of a flexible cord; endocyst not differentiated, and the polypide consequently unattached to its cell; retractor and other muscles absent; a large, shield-like organ (foot) placed near the mouth; the young (bud) furnished with two valve-like fleshy plates.*

Genus RHABDOPLEURA, Allman.

Der. From ῥάβδος, rod, and πλευρά, side.

RHABDOPLEURA, Allman (1867).

HALILOPHUS, M. Sars (1868)*.

The only genus.

OF this remarkable form, which constitutes the type of

* 'Forsatte Bemærkninger om det dyriske Livs Udbredning i Havets Dybder,' p. 12.

a distinct Subclass, we have an account from Allman and from G. O. Sars: the former has studied our British *R. Normani*; whilst the latter has given us an exhaustive memoir on a Scandinavian species, *R. mirabilis*, founded on a careful examination of living specimens. The most significant peculiarities of *Rhabdopleura* are the structure of the lophophore and the disposition of the tentacles upon it. Instead of a circular or crescentic stage round which the arms are ranged in a continuous series, we have here two long and narrow and more or less divergent lobes, extending out from the anterior region of the body in a dorsal direction, and each bearing a double row of tentacles. The tentacular wreath has disappeared; and in its place we have two independent tentaculiferous processes, which are highly flexible and mobile, reminding us more of the "gill-tentacles" of *Terebratula* than of the lophophore of the ordinary Polyzoa.

Another striking feature of the present form is the large shield-like organ ("buccal shield") situated between the two orifices of the alimentary canal, which is probably the homologue of the Molluscan foot*. According to Sars's observations, it is by means of this organ (in the absence of all protrusor muscles) that the polypide slowly draws itself up to the mouth of the cell.

* Allman, indeed, takes a different view of this organ, based chiefly on observations made on the early development of the polypide, and is inclined to compare it with the mantle of a Lamellibranchiate mollusk. His account of the evolution of the bud I am unable to follow so as fully to appreciate its bearing on the point in question; but there seem to me to be serious objections to the proposed interpretation. Sars regards the shield as the equivalent of the epistome of the Freshwater Polyzoa; and Prof. Ray Lankester identifies it with the Molluscan foot,—conclusions in which (with our present knowledge) I fully concur.

The relation of the polypide to its dwelling in *Rhabdopleura* is totally unlike that to which we are accustomed in the ordinary, typical polyzoon. There is no endocyst, or at most only the remains of one, and consequently no tentacular sheath; and the polypide is therefore wholly unconnected with its cell. With the endocyst or enveloping sac go the perigastric cavity and the system of muscles by which the polypide is moved up and down within it. Its only connexion is with a cylindrical chitinous rod, inclosing a soft, cellular core, and traversing the whole of the adherent portion of the zoarium, to which it is attached by means of a contractile cord. This cord is united to the body of the polypide, not at the bottom of the stomach, but some way up on one side; it possesses a high degree of contractility; and it is by means of it that the retraction of the polypide is effected. It is probably homologous with the "funiculus" of the ordinary polyzoon, whilst in the soft core of the axial rod (which, according to Sars, resembles in structure the contractile cord) we may recognize the equivalent of the endosarc as it appears (for instance) in the stems of the *Ctenostomata*. The septate condition of the adherent portion of the cœnœcium has also its parallel in the latter.

The polypide, as we might expect, is sluggish in its movements, both in issuing from its cell and retreating, and has none of the activity of its tribe.

The annulated condition of the chitinous cœnœcium is also a peculiarity which does not occur in the other known Polyzoa. In the general character of the zoarium, as well as in several other important points, the present form makes an approach to the freshwater group of the *Phylactolæmata*.

Rhabdopleura ranges from about 100 to 300 fathoms, and, according to Sars, is most plentiful at the greatest depths*.

RHABDOPLEURA NORMANI, Allman.

Plate LXXXII. figs. 1, 2, and 4-7.

RHABDOPLEURA NORMANI, *Allman*, in Rep. on Shetl. Dredgings, Rep. Brit. Assoc. for 1867 (1868), 311; Quart. Journ. Micr. Sc. n. s. ix. (1869) 57, pl. viii.

Zoarium subalternately branched, delicate, transparent and colourless; the tubular cells rising at the extremity of the branches, of the same diameter as the adherent portion, closed below by a thin transverse septum, distinctly and regularly annulated.

IN this species the cells are adherent at their commencement, like the other portions of the cœnœcium, but soon become free and erect. They are beautifully annulated, whilst the adherent portions of the tube are crossed by faint ridges, which pass obliquely from each side towards the centre, intercepting each other in their course. The axial cord is opaque and dark-coloured, and shows very conspicuously through the hyaline walls of the tube. According to Allman, certain bodies, clothed in a dark-brown chitinous capsule, are developed on the funiculus, which he regards as probably equivalent to the "stato-blasts" of the freshwater Polyzoa.

HABITAT. On dead shells from deep water.

LOCALITY. Shetland, Outer Haaf, off Unst, 93 fathoms (A. M. N.).

* See a paper, "On *Rhabdopleura mirabilis* (M. Sars)," by George Ossian Sars, 'University Programme' for the first half-year, 1869: Christiania, 1872. Reprinted in the Quart. Journ. Micr. Sc. vol. xiv. n. s. Also Allman, "On *Rhabdopleura Normani*," Quart. Journ. Micr. Sc. January 1869; and "On the Relations of *Rhabdopleura*," Journ. Linn. Soc., Zool. vol. xiv. p. 581.

RHABDOPLEURA COMPACTA.

Plate LXXII. figs. 8, 8a, 9.

Zoarium composed of delicate chitinous tubes laid closely side by side, and forming small, crust-like colonies; erect, annulated cells, of very moderate height, rising at intervals from the adherent portions; many dark-coloured somewhat oval bodies, with a chitinous covering, in the course of the axial rod, developed on its upper surface.

R. COMPACTA differs remarkably from the preceding, and also from the Scandinavian *R. mirabilis*, in its habit of growth. Instead of a creeping, more or less ramified zoarium, it forms minute, compact crusts, composed of tubes placed side by side, and closely appressed one to the other. The erect cells seem to be short as compared with those of *R. Normani*; they are given off, I believe, at intervals, in the course of the adherent tube, as in *R. mirabilis*, and not merely at the extremity of the branches, and probably rise one from each compartment of the stem. The precise mode in which the adherent tubes are disposed and the cells originate I am unable to determine, as my specimens, which are mere specks on the surface of old shells dredged years ago, are much shrivelled up, and do not show many of the structural details. They leave no doubt, however, as to their true nature; and the habit of growth is so marked as to separate them from both the known species. The axial cord, which is of a very dark colour, is admirably preserved, as are also certain oval bodies in its course, which are probably the so-called statoblasts of Allman (Plate LXXII. fig. 9). They occur usually just below the expansions of the rod, to which the funiculus was attached.

R. compacta is one of the many interesting forms for a knowledge of which we are indebted to Mr. Hyndman's enthusiasm and practical skill as a dredger.

HABITAT. On shells from deep water.

LOCALITY. Coast of Antrim (Hyndman).

"Multum adhuc restat operis, multumque restabit, nec ulli nato post mille sæcula præcludetur occasio aliquid adjiciendi."—SENECA.

LIST OF WORKS

AND

PAPERS ON THE POLYZOA.

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“Ce n'est que par les travaux successifs de plusieurs hommes sur le même objet, qu'on parvient à le connaître parfaitement. Un seul architecte ne peut tracer le plan, rassembler les matériaux et élever l'édifice.”—  
LAMOUROUX.

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## EXPLANATION OF INITIALS.

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|               |                          |
|---------------|--------------------------|
| A. H. H. .... | Arthur Hill Hassall.     |
| A. M. N. .... | Alfred Merle Norman.     |
| C. W. P. .... | Charles William Peach.   |
| D. L. ....    | David Landsborough.      |
| G. S. B.....  | George Stewardson Brady. |
| J. Y. J. .... | J. Yate Johnson.         |
| S. W.....     | Searles Wood.            |
| T. H.....     | Thomas Hincks.           |
| W. T. ....    | William Thompson.        |

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## CORRIGENDA.

Pages 90, 91. For *B. fastigiata* read *B. purpureotincta*.

Page 379, seventh line from the top. After "Minch" read a semicolon instead of a comma.

Page 449, footnote, fifth line from the bottom. For more read much.

Page 532, eleventh line from the top. For Plate LXII. read Plate LXXII.

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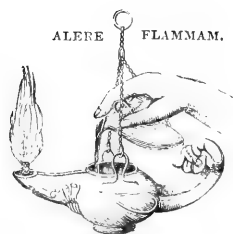
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\* See Introduction, Systematic Table.



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